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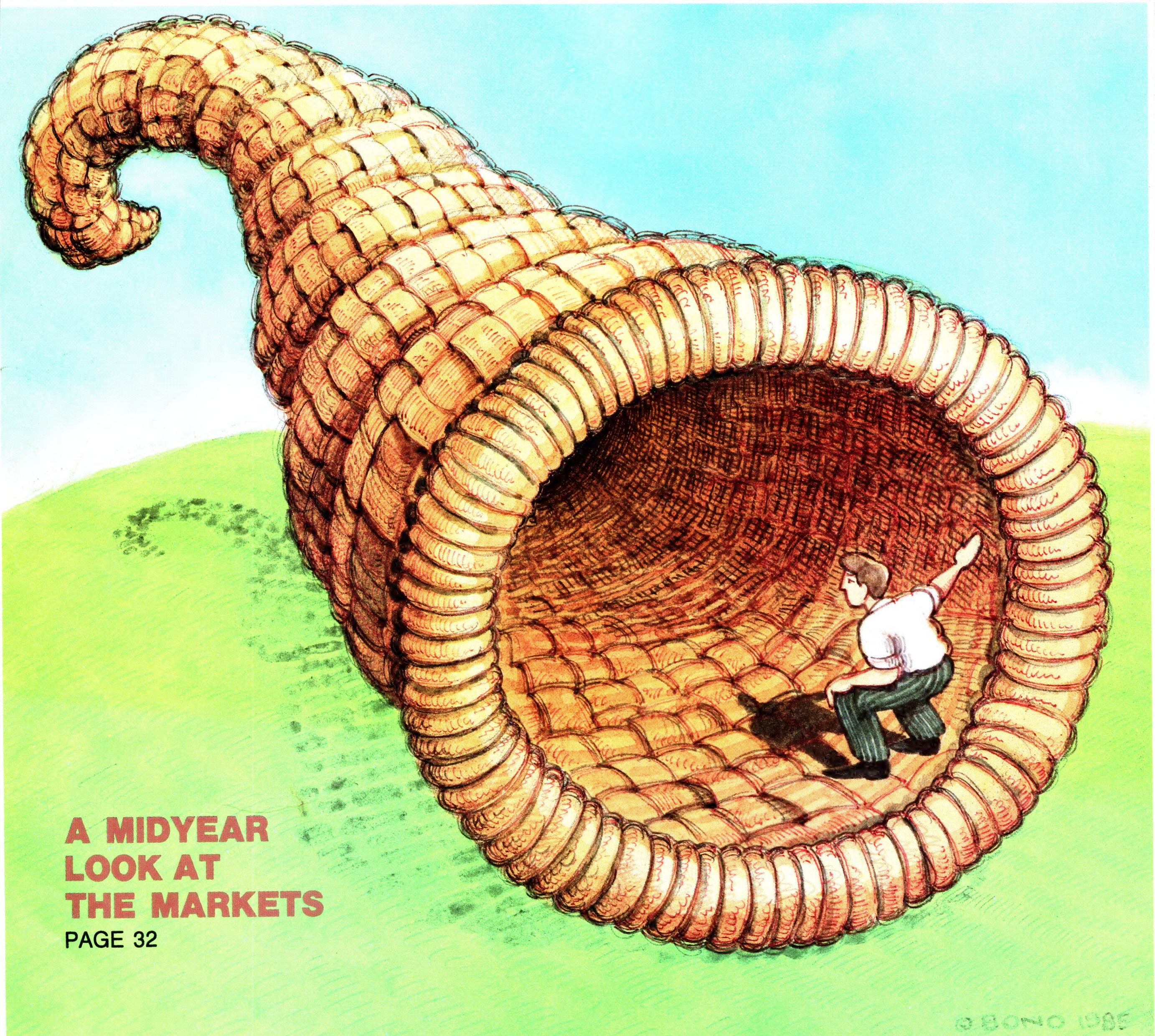
THREE DOLLARS

Electronics

THE WORLDWIDE TECHNOLOGY WEEKLY

JUNE 24, 1985

WHEN WILL THE TURNAROUND COME?



A MIDYEAR LOOK AT THE MARKETS
PAGE 32

SILICON COMPILERS: DESIGNERS NOW HAVE A CHOICE/58

AT LAST, ERASABLE OPTICAL DISK NEARS MARKET/67

UNIX IS A TRADEMARK OF AT&T BELL LABORATORIES. SERIES 32000 IS A TRADEMARK OF NATIONAL SEMICONDUCTOR CORPORATION.

"What's on your mind, Jerry?"

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"And, as usual, they need it yesterday."

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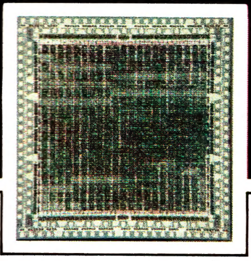

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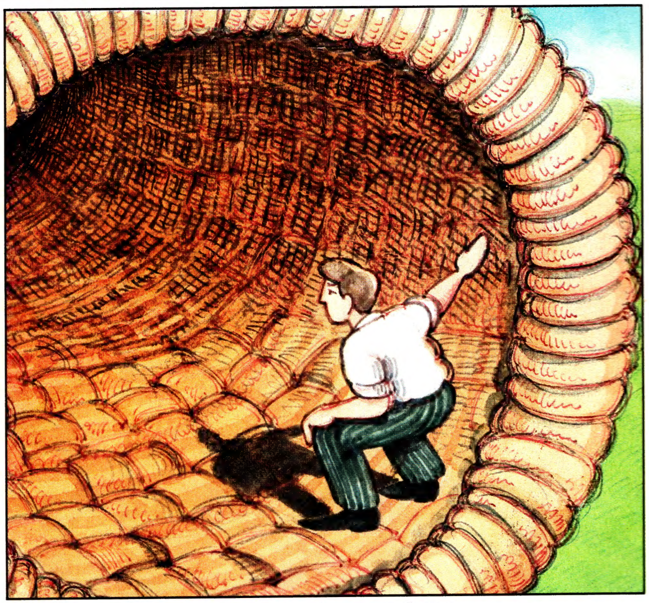
JUNE 24, 1985 VOLUME 58, NO. 25

Electronics

COVER



When will the turnaround come? 32
U.S. computer and semiconductor makers in particular are taking a beating, but the entire electronics industry is getting hit hard—layoffs, plant closings, and product stretch-outs are increasing as the recession deepens. When will it end? The answer from the experts is, "Wait until next year"
Cover illustrated by Peter Bono

SPECIAL REPORT

Silicon compilers: designers now have choice, 58
In the burgeoning marketplace for application-specific ICs, better software-design tools are needed to reduce turnaround time and yield more silicon-efficient chips. Promising to be among the most powerful of the tools are silicon compilers that capture the expertise of silicon design specialists

TECHNOLOGY READOUT

At last, an erasable optical disk nears market, 67
A working prototype of an erasable removable optical disk, the forerunner of a product that could revolutionize mass storage, has been built by Verbatim, which will display it at the upcoming National Computer Conference

PROBING THE NEWS

Broadcasters balk at new TV technologies, 38
The next TV revolution is expected to involve a combination of interactive cable services and direct-broadcast satellites. But even though the technology is ready, broadcasters, pleading financial troubles, are loath to adopt the new ways. Judging from the recent Montreux symposium, the next technology explosion may not happen for a while

NEWS

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Honeywell will market semicustom digital signal processors, and AT&T is eyeing the market, too

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Daisy's next generation of work stations uses multiple processors to take on more of the arithmetic-intensive jobs, such as simulation

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Genrad's Hilo package now does device modeling

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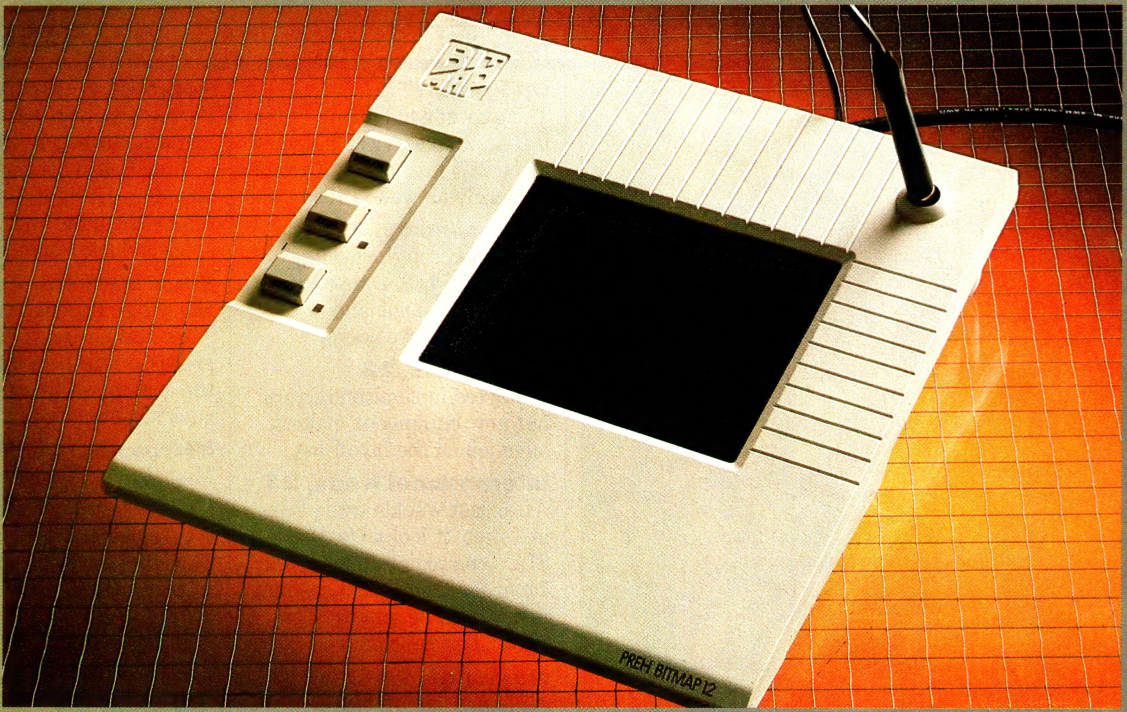
PREH BITMAP S 12 CD



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PUBLISHER'S LETTER

Every issue of *Electronics* is dramatic evidence of the global nature of the technology as well as the unmatched worldwide reporting resources of the magazine. This week we may have outdone ourselves.

The midyear market report on p. 32, taken alone, is impressive enough. But add to that a wide-ranging collection of news items from our reporters stationed overseas and you can understand why we are so proud of our ability to report quickly from anywhere in the world. That package includes:

- A roundup on p. 22, from around the country, describing layoffs throughout the U.S. computer and semiconductor industries;
- A description on p. 23, from Washington and Tokyo, of the U.S.-Japanese trade discussions;
- The p. 24 report, from Silicon Valley, on the effect on EPROM pricing of the Japanese entry into the market;
- The story on p. 28, from Seoul, about Daewoo's five-axis robot that is billed as a low-cost solution.

An example of how our editorial system works is the six-page report on the current hard times of electronics manufacturers. After the editors in New York discussed the story and what shape and direction it should take, an assignment went to our bureaus in New York, Chicago, Dallas, Palo Alto, Los Angeles, Tokyo, Frankfurt, Paris, and London. Reporting from those offices went to five editors, each of whom was responsible for a section of the report. Finally, their work was put together by Business Editor Robert J. Kozma.

Even as Kozma was compiling the report, art director Fred J. Sklenar's department—associate director Sachiko Soskin and art assistant Annamaria Palma—were creating a design for the pages that enhanced the impact of the cover as well as the text. We are proud of the result and also of that kind of teamwork, which occurs routinely at *Electronics.*

Veteran reporters know that a story or an idea for one can come anywhere and anytime. So it was no surprise to our man in Paris, Robert Gallagher, that the basis for his report on the annual Montreux symposium on broadcasting (p. 38) grew out of a conversation overheard aboard a funicular in the Alps.

He had gone to Montreux, in Switzerland, with the idea of doing his story about the evolution of TV services. Gallagher was staying at a hotel in the mountains above the city, which is where the funicular (a cross between a train and cable car) came in. He had to ride one from the hotel to the symposium site, and on one of his trips overheard two British engineers sitting behind him talking about the TV of tomorrow display at the meeting hall.

"Really very impressive," said one, "it's a shame it isn't going to happen. I thought the general opinion is that cable and DBS were in trouble." When he arrived at the meeting, Gallagher nosed around and asked his questions based on that overheard premise and *voilà,* our story is the result.

Laurence Altman

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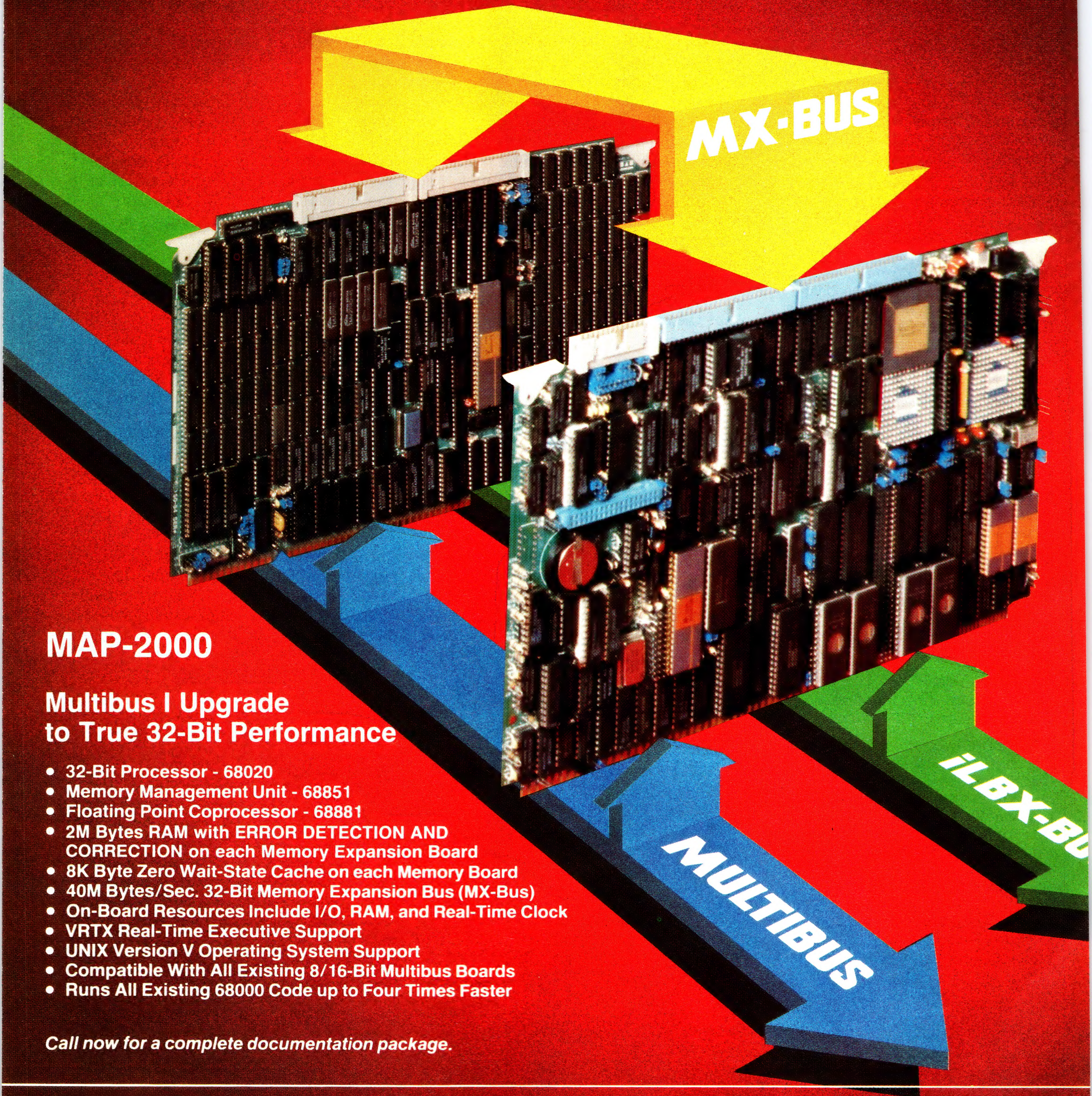

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THIS Electronics WEEK

THURSDAY *June 13*

Xerox Corp. said it signed a five-year contract allowing **Xerox telecopier facsimile machines to be manufactured and sold in the People's Republic of China** by the Beijing Instrument Industry Corp. Financial details were not released, but the Stamford, Conn., company said more than 15,000 machines are expected to be produced over the five-year period at the Beijing plant. The units will be assembled in the People's Republic from parts furnished by Xerox's Japanese affiliate, Fuji Xerox Co.

FRIDAY *June 14*

Apple Computer Inc. pared its work force by 22%, laying off 1,200 employees in an attempt to slim down and weather the industrywide recession. Storage Technology Corp. also said it would eliminate 500 jobs. The two joined a host of other firms that have used mass layoffs as a means to endure recent hard times (see story, p. 22). . . . Anderson Jacobson Inc., San Jose, Calif., and Multi Soft Inc. of Metro Park, N.J., agreed to jointly develop **a distributed data-communication software package to integrate mainframe-to-microcomputer applications.** The new package integrates the salient features of AJ's Term Plus terminal emulator, according to Multi Soft, into a new system that can run under the MS-DOS or S1 operating systems and will cost between $10,000 and $30,000.

MONDAY *June 17*

Merger talks between Burroughs Corp. and Sperry Corp. ended without a deal. The combination would have made the two the world's second-largest computer maker. Burroughs, based in Detroit, had offered $65 per share or $3.68 billion for Sperry, of New York. Burroughs charged in a written release that some Sperry officials had made it "impossible to negotiate an alliance within a reasonable amount of time." . . . Officials from the Consortium for Scientific Computing, the 12 universities supporting the development of the John von Neumann supercomputer center at Princeton University, announced formal agreement with the National Science Foundation, which is supplying the CSC with more than $70 million over a five-year period. Based on the ETA^{10}, the latest generation of supercomputers being development by ETA Systems, of St. Paul, Minn., the system will operate at 10 gigaflops—about 10 billion calculations/s. Consortium members **will access the supercomputer with remote VAX-11/750 computers and high-speed communications links** that can transmit 1.5 million b/s.

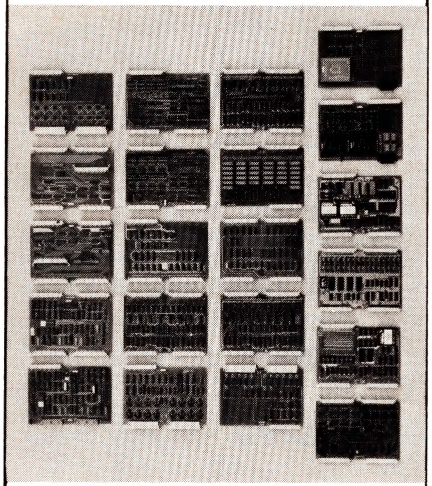
TUESDAY *June 18*

Digital Equipment Corp. introduced **a color work station based on the high-speed floating-point processor used in DEC's Microvax II.** The Vaxstation 520, which also features a Tektronix Inc. 4125 graphics subsystem, has 2 megabytes of main memory, a 32-megabyte Winchester disk, and a pair of 400-K-byte floppy-disk drives. A DEC spokesman said the company expects the $42,790 station's high resolution and large internal memory to pose a major challenge to work stations from Sun Microsystems and Apollo.

WEDNESDAY *June 19*

Nineteen companies have agreed to use Xerox's Interpress page-description language as a common electronic printing standard for computers, officials from the company said today. The companies include Burroughs, DEC, Siemens, Imagen, and Interleaf, among others. □

VMEbus Products



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MEETINGS

AACC Trends '85 Conference, Association of Agricultural Computing Companies (Cara Doyle, 146 E. Milwaukee St., Jefferson, Wis. 53549), Abbey Hotel, Fontana, Wis., Aug. 1-2.

International Symposium on New Directions in Computing, Institute of Electrical and Electronics Engineers (New Directions in Computing, P.O. Box 639, Silver Spring, Md. 20901), Norwegian Institute of Technology, Trondheim, Norway, Aug. 12-14.

Ausgraph '85, Australasian Computer Graphics Association Inc. (P.O. Box 29, Parkville, Victoria, Australia 3052), Crest International Hotel, Brisbane, Australia, Aug. 12-16.

Computer Graphics '85 East, National Computer Graphics Association (8401 Arlington Blvd., Fairfax, Va. 22031), Bayside Convention Center, Boston, Aug. 13-15.

Second International Forum on Micro-Based CAD, Autodesk Inc. (Colorado State University, Department of Industrial Sciences, Fort Collins, Colo. 80523), Colorado State University, Fort Collins, Aug. 14-16.

The Seventh Conference of The Cognitive Science Society, Cognitive Science Society (1845 S. Elena Ave., Redondo Beach, Calif. 90277), University of California at Irvine, Aug. 15-17.

29th International Technical Symposium on Optical and Electro-Optical Engineering, Society of Photo-Optical Instrumentation Engineers (P.O. Box 10, Bellingham, Wash. 98227-0010), Town and Country Hotel, San Diego, Aug. 18-23.

The 28th Midwest Symposium on Circuits and Systems, University of Louisville (Electrical Engineering Department, University of Louisville, Louisville, Ky. 40292), The Galt House, Louisville, Ky., Aug. 19-20.

International Machine Tool Research Forum, National Machine Tool Builders' Association (7901 Westpark Dr., McLean, Va. 22102), Hyatt Regency O'Hare Hotel, Chicago, Aug. 20-21.

8th International Conference on Production Research, International Foundation for Production Research *et al* (Fraunhofer Institute for Production Technology, Nobelstrasse 12, P.O. Box 800 469, 7000 Stuttgart 80, West Germany), University of Stuttgart, Stuttgart, Aug. 20-22.

CAEDEX '85—International Conference and Exposition on CAE Workstation Technology, CMP Publications Inc. (Access Conference Associates Inc., P.O. Box 160, Gaithersburg, Md. 20877), Long Beach Convention Center, Long Beach, Calif., Aug. 20-23.

14th International Conference on Parallel Processing, Pennsylvania State University and IEEE (IEEE Computer Society, P.O. Box 639, Silver Spring, Md. 20901), Pheasant Run Resort, St. Charles, Ill., Aug. 20-23.

Worldesign '85/ICSID USA, Industrial Designers Society of America, (Design Foundation, 1360 Beverly Rd., McLean, Va. 22101-3671), Sheraton, Washington, Aug. 20-24.

Advances In Impactless Printing, Institute for Graphic Communication Inc. (375 Commonwealth Ave., Boston, Mass. 02115), Holiday Inn on the Beach, Monterey, Calif., Aug. 25-27.

VLSI '85 International Conference, International Federation for Information Processing (Business Center for Academic Societies, 4-16 Yayoi 2-chome, Bunkyo-ku, Tokyo 113, Japan), Keidanren Kaikan, Tokyo, Aug. 26-28.

Seventh International Symposium on Computer Hardware Description Languages and their Applications, International Federation for Information Processing *et al* (Tohru Moto-oka, University of Tokyo, Hongo, 7-chome, Bunkyo-ku, Tokyo, Japan), Keidanren Kaikan, Tokyo, Aug. 29-31.

Seminars

Unix/Xenix Seminar, Center for Advanced Professional Education (1820 E. Garry St., Suite 110, Santa Ana, Calif. 92705), Registry Hotel, Bloomington, Minn., Aug. 5-6; Marriott Inn-East, 2124 West Hamilton Rd., Columbus, Ohio, Aug. 7-8.

Fiber Optic Communications Systems, University of California, Santa Barbara (University of California Extension, Santa Barbara, Calif. 93106), Engineering Building, UCSB, Aug. 5-9.

ESD Control Course, SAR Associates Inc. (RR 2, Box 500, Rome, N.Y. 13440), Marriott Hotel, Pittsburgh, Aug. 6-7.

Fiber Optics Markets, Information Gatekeepers Inc. (Bob Casey, Information Gatekeepers Inc., 214 Harvard Ave., Boston, Mass. 02134), Logan International Airport, Boston, Aug. 21.

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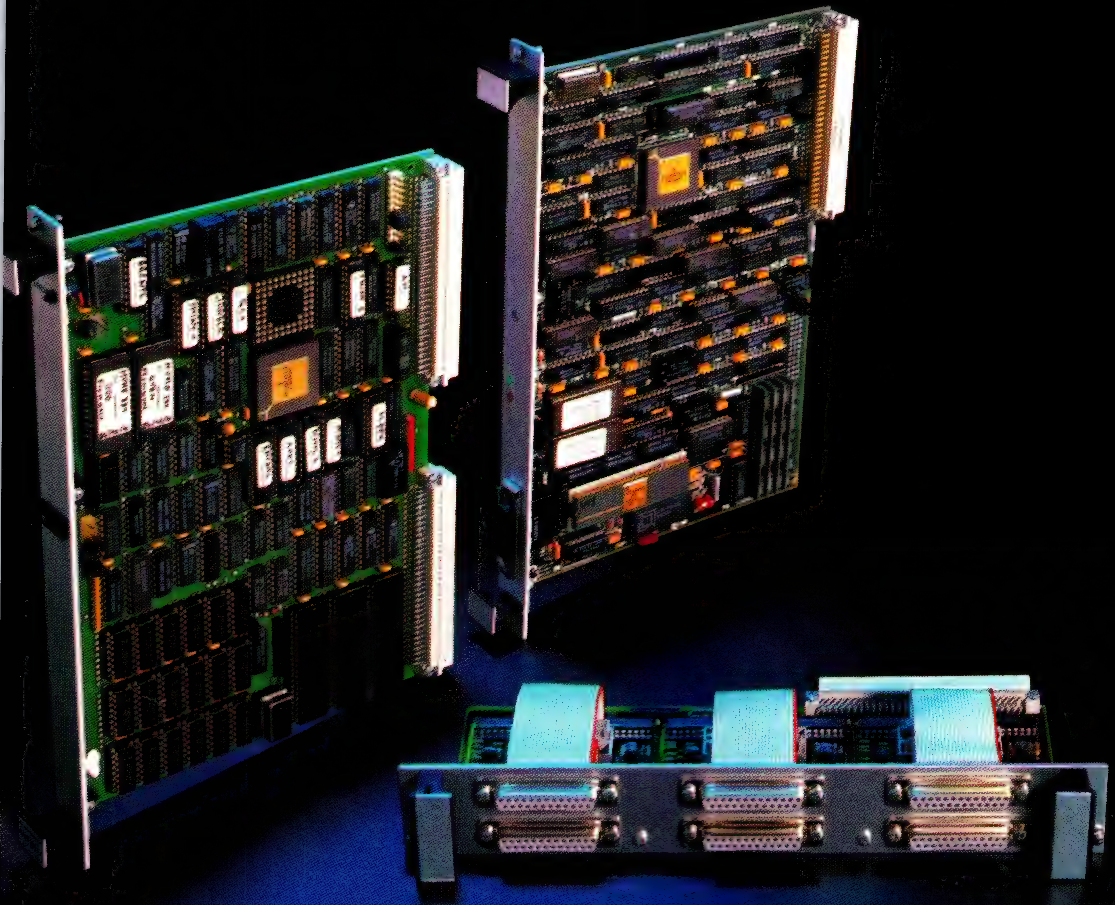
* OS-Independent firmware and drivers for VERSAdos and SYSTEM V/68 (UNIX)



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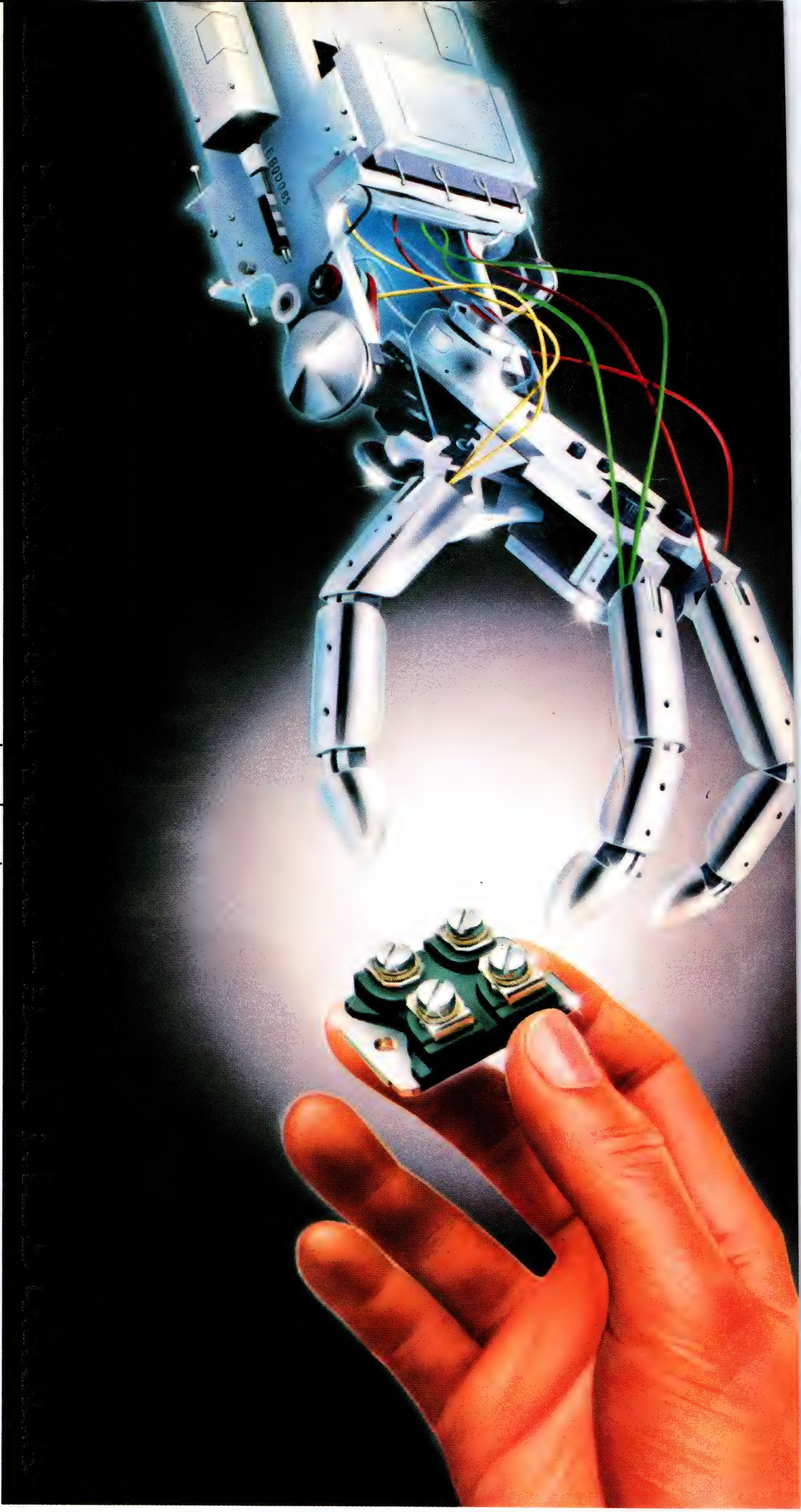

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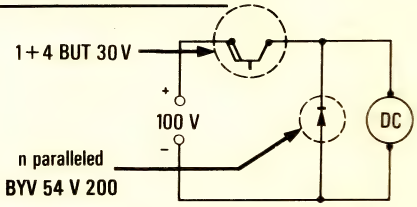

BUT 30 V transistor

V_{CEW} = 125 V

$I_{C\,(sat)}$ = 100 A at $I_{B\,(sat)}$ = 10 A

BYV 54 V 200 diode

V_{RRM} = 200 V

$I_{F(AV)}$ = 2 x 50 t_{rr} = 60 ns

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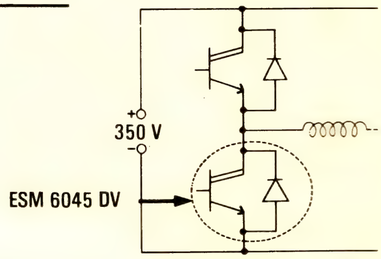

ESM 6045 DV Darlington with fast recovery antiparallel diode

V_{CEW} = 450 V $I_{C(sat)}$ = 50 A at $I_{B(sat)}$ = 1 A

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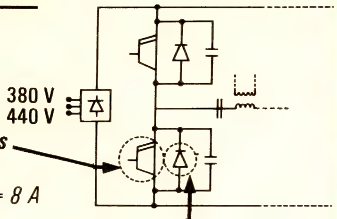


BUV 298 AV transistors

V_{CEW} = 400 V

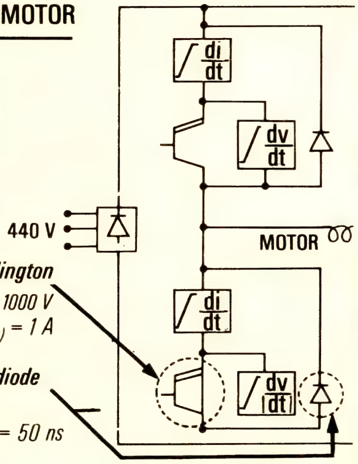
$I_{C(sat)}$ = 40 A at $I_{B(sat)}$ = 8 A

BYT 230 PIV 1000 diodes

V_{RRM} = 1000 V

$I_{F(AV)}$ = 2 x 30 A t_{rr} = 50 ns

20 KHz AC SERVOMOTOR



ESM 6045 AV Darlington

V_{CEW} = 450 V, V_{CEV} = 1000 V

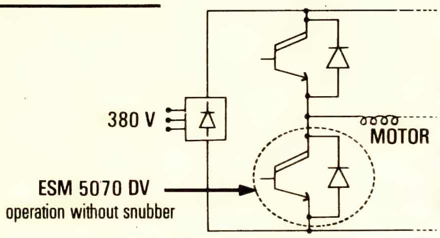
$I_{C(sat)}$ = 50 A at $I_{B(sat)}$ = 1 A

BYT 230 PIV 1000 diode

$I_{F(AV)}$ = 2 x 30 A

V_{RRM} = 1000 V t_{rr} = 50 ns

5 KVA - 8 KHz - AC DRIVE



ESM 5070 DV darlington with fast recovery antiparallel diode

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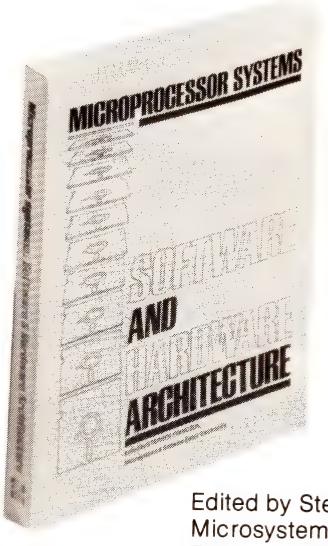

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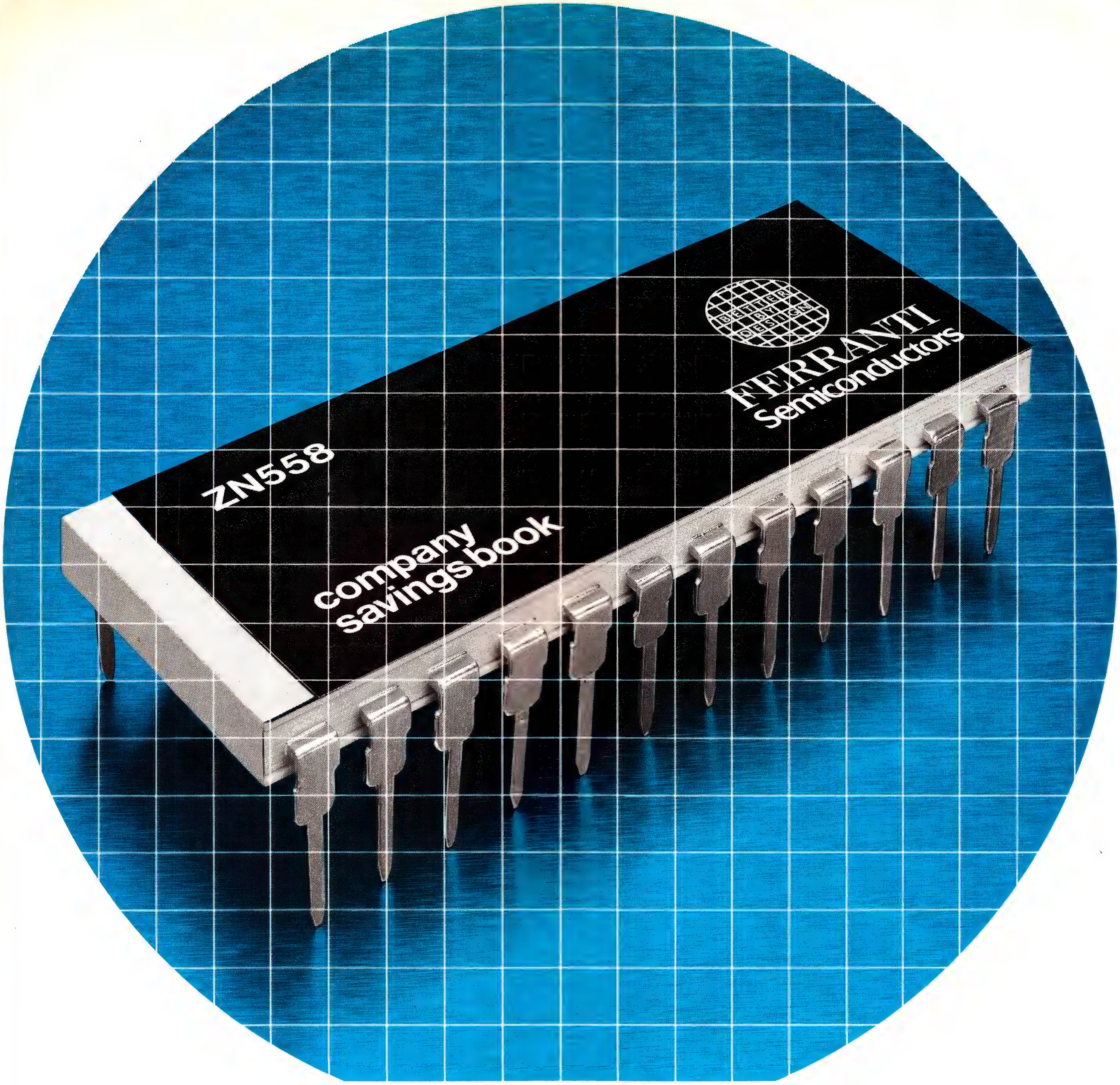

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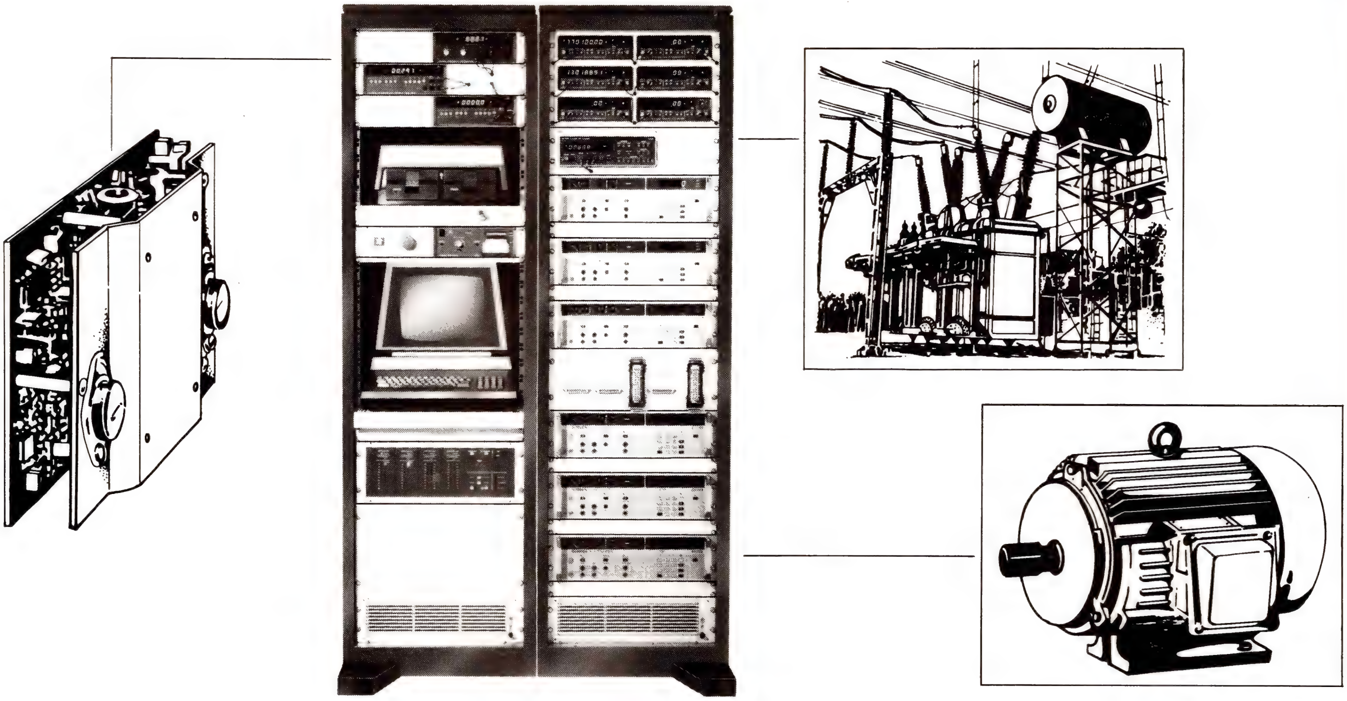

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UP FRONT

Information-services industry advanced 24% in 1984

The U.S. information-services industry grew 24% in 1984, but it probably won't do as well this year. Industry revenues rose to $39.9 billion from 1983's $32.2 billion, according to Input Inc., the San Jose, Calif., market research firm that studies the industry. This represented the industry's fastest-ever rate of growth, considering this was "real growth, with very little [product] price increases," said Input president Peter A. Cunningham, who released his firm's latest industry research at a meeting last week of Adapso, the Computer Software and Services Industry Association, Arlington, Va. Looking at 1984, Cunningham said the industry had "intense" growth in the first half from "the release of pent-up demand after the recession." However, growth dropped off in the second half, and this carried over into 1985. Still, Cunningham forecast that the industry—which includes vendors of processing services, software products, professional services, and turnkey systems—will grow "at least 20%, and perhaps 22%, for the next five years," with revenues possibly hitting $104 billion by 1989. ☐

RCA, Sharp pick Washington State for joint-venture chip plant

Those new chip-making partners, RCA Corp. and Sharp Corp., have decided where their new joint venture—called RCA/Sharp Microelectronics Inc.—will set up shop: Camas, Wash., near Vancouver. Scheduled to open in the first quarter of 1987, the $200 million plant eventually will employ 650 people and a variety of sophisticated robots. Production targets call for 750 6-in. wafers per day. Integrated circuits made at the new facility will be sold to the two parent companies, which will handle all assembly, testing, and marketing. The joint venture includes plans for design and wafer-fabrication facilities to develop and manufacture CMOS very large-scale chips, as well as custom and semicustom circuits. ☐

Sinclair Research finds a white knight, processes first wafer-scale circuits

Britain's financially troubled home computer maker, Sinclair Research Ltd., last week found a white knight in newspaper proprietor and publisher Robert Maxwell, who will invest $15.4 million in return for 75% ownership. This gives the Cambridge company a value of roughly $20 million versus $177 million in February 1983. Sinclair's troubles started after the Christmas sales rush when it was left with $44 million worth of unsold inventory. Ironically, on the day of Sinclair's rescue, its Metalab research laboratory said that a first batch of wafer-scale circuits, half-megabyte file stores for the QL personal computer, had been successfully processed by STC Semiconductors Ltd. Sinclair denies the wafer-scale project will now be sold or licensed and says it still plans to raise $65 million for the venture. ☐

IBM adds PC to its System/36, offers machine through retailers

IBM Corp. last week brought out an entry-level model of its System/36 small computer system. The unit, which fits on or under a desk, is coupled with an IBM Personal Computer. The PC can operate either as a standard PC, as the system console, or as a System/36 work station at the push of a button. Called the System/36 PC, it is multitasking and can support up to four local work stations. Intended as a starter system for small companies, it comes with a 40-megabyte 5¼-in.-hard-disk drive—the first such disk made by IBM. The 5364 processor—another name for the System/36 PC—with 256-K bytes of main memory and the 40-megabyte disk drive, priced at $5,995 ($8,090 with an 80-megabyte drive), is the first IBM computer—other than the PC—to be be sold by authorized retailers as well the IBM sales force. ☐

UP FRONT

NCR cuts price, unveils development tools for systolic-array chip

With the reduction of price and the introduction of development tools for its Geometric Arithmetic Parallel Processor (GAPP) chip, NCR Corp.'s Microelectronics Division is serving notice of its continuing commitment to push market acceptance of the unconventional device. Introduced late last year, the GAPP integrates 72 individual 1-bit processors—each with its own 128 bits of memory—on the same CMOS chip [*ElectronicsWeek,* Nov. 12, 1984, p. 17]. It is believed to be the first commercially available processor chip to be based on a systolic-array architecture. Now available is the GAPP PC Development System for use on the IBM Corp. Personal Computer and compatible machines, as well as the GAPP Simulator/Assembler software package for use in either a Digital Equipment Corp. VAX/VMS or VAX/Unix environment. The personal computer-based system includes a hardware board with two GAPP chips and development software for $3,500. The VAX-based software package is priced at $995. NCR has cut the GAPP chip's price to $150 each in 1,000-unit quantities from $545 set at introduction in 1- to 24-unit quantities. ☐

ITT Semiconductors Group signs technology-transfer agreement with China

Following a recent $4 million technology-transfer agreement between the Chinese Electronics Import and Export Corp. and the ITT Semiconductors Group, China will begin production of ITT tuner diodes this September in a discrete-devices factory in Tianjin, an industrial town 70 miles south of Beijing. Production of the tuner diodes—for very-high and ultrahigh frequency TV applications—will be on ITT-supplied and -installed equipment and with personnel trained at Intermetall GmbH, the U.S. group's lead house in Freiburg, West Germany. Initially, ITT will supply the materials, including the silicon, needed for device fabrication. ITT is banking on follow-up deals involving parts for entertainment electronic applications, an ITT strength. ☐

Robotics manufacturers continue to prosper

Amid the general gloom in the electronics industry, one sector continues to prosper: robots. This month, the Robotic Industries Association reported that U.S. robot suppliers are experiencing impressive growth. Record shipments were posted in 1984: 5,136 units valued at $332.5 million, a gain of 68% in units, and 71% in dollar value over 1983. New orders in the first quarter of 1985 totaled 1,834 robots valued at $185.7 million. The jump in new orders resulted in an industry backlog of 2,918 units worth $427.3 million, more than double that of the same period a year ago. The strong backlog, the RIA says, virtually ensures another recording-breaking year for the U.S. robotics industry. He estimates that about 16,000 robots are in use in the U.S., up from 6,300 at the end of 1982. ☐

Zilog seeks to revive microprocessor fortunes with new pacts

Zilog Inc., the Campbell, Calif., chip-making affiliate of Exxon Corp. that is now undergoing a revival under new president Edgar A. Sack Jr. [*ElectronicsWeek*, May 27, p. 14], last week announced a series of second-source agreements and a liaison with an application-specific integrated-circuit firm. The new partner is VLSI Technology Inc. of San Jose, Calif., which will help Zilog adapt its Z-series processors and peripherals into standard cells that users can design into custom chips. Zilog will also second-source two Advanced Micro Devices Inc. Ethernet chips; the popular Nippon Electric Co. 7220A graphics controller; and two of NEC's V series microprocessors, which have the same instruction sets as Intel Corp.'s 8086/8088. ☐

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Electronics

BELEAGUERED FIRMS CUT WORK FORCES BY 20,000

As sales slide, computer companies and chip makers turn to layoffs and short work weeks

Palo Alto

The U.S. electronics industry is wielding its layoff axe with mounting vigor these days. Payrolls aren't just being trimmed, they're being slashed. And as the cuts mount in a widening spiral, equipment makers are joining their semiconductor brethren in an industry-wide retrenchment.

Employment in the industry hit an all-time high—2.61 million—in December, according to an American Electronics Association study of U.S. Labor Department statistics. That figure has been falling ever since, with a net loss of 20,000 jobs in the first two months of 1985 cutting into the 230,000 jobs added in 1984. And the pace of layoffs has heated up as the summer months approach (see related story, p. 32).

In California's Santa Clara County, which depends on the electronics industry for 25% of its jobs, employment at electronics companies hit a high of 206,000 in December. In April alone, 1,400 jobs were lost. Labor analyst Ricka Pirani of the state Employment Development Department expects "very similar drops" in May and June. She shares the common view that "it's going to get worse before it gets better."

Bright spots are rare. Lockheed Missiles and Space Co., the county's largest employer, is one of the few with a large hiring program. Fueled by defense contracts, Lockheed plans to add 1,500 jobs this year, bringing to 24,000 the number of workers it will employ in the area by the end of the year.

But Lockheed's call for workers is lost amid the groans of layoffs and plant closings at a host of other high-tech companies across the country. The latest cuts came at Data General, Hewlett-Packard, and Motorola's Semiconductor Sector.

Last week, Data General Corp. laid off 1,300—just over 7%—of its 18,000 employees. The Westboro, Mass., company's remaining employees are subject to a two-week shutdown early next month. "The erratic character of demand makes it difficult to predict either revenues or profitability beyond the next few months," says company president Edson D. de Castro.

Time off. In the same week, Hewlett-Packard Co. in Palo Alto asked all of its 84,000 employees to take three days off in July as vacation or unpaid time off. With the already scheduled July 4 holidays, most of HP's U.S. sites will be closed that entire week. It is the first time since 1970 that the company has instituted such a shutdown.

As for Motorola Inc., it departed from its no-layoff policy for permanent workers last week, furloughing 45 people at its Austin, Texas, plant. Motorola already had a "voluntary" layoff plan in effect in Phoenix, Ariz. (see "Pink slips blossom in high-tech land," p. 23).

The other shoe dropped at Apple Computer Inc. Following a management shakeup and corporate reorganization [*Electronics Week*, June 10, 1985, p. 16], the Cupertino, Calif., company axed 1,200 workers on June 14. Since the beginning of the year, about 260 employees laid off and 1,300 temporary contract workers were let go at various sites, leaving the company with about 4,600 on the payroll. The retrenchment moves production of the Apple IIc to the company's highly automated Macintosh production facility in Fremont, Calif.

And LSI Logic Corp. of Milpitas, Calif., a semiconductor maker and leader in the market for gate arrays, plans a three-day shutdown early in July that will affect 1,000 employees. The company plans to shut down for an additional week later in the summer.

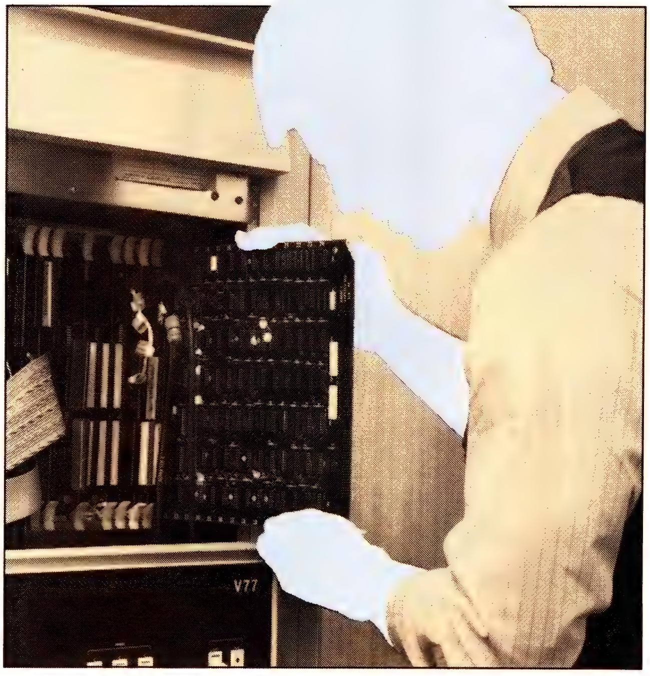
Reflecting the woes in the personal computer market, Computerland Corp., Oakland, Calif., the computer retail chain, has cut its staff by 10%.

The manufacturing slowdown is less clear-cut abroad. Japanese firms do not have general layoffs during market slumps; they trim back production instead. Vertically integrated giants such as NEC, Hitachi, and Toshiba can shift laborers from slow areas (such as semiconductors) to hotter areas (such as video recorders).

Even the Japanese arm of Texas Instruments Inc. avoided layoffs last fall. It cut its schedule of constant production down to its current work cycle of five-day weeks with no overtime.

However, some European firms have followed the U.S. pattern. In March, the UK's Inmos International plc cut the hours of its 900 employees in Newport, Wales, by 20%, and laid off 7.5% of its workers in Colorado Springs.

In West Germany, Siemens AG put 500 of its 1,400 employees at a memory plant in Villach, Austria, on short work weeks. *–Eve Bennett*



Unemployed. Faces are disappearing in the electronics industry's workplaces as firms lay off thousands of workers to survive its slump.

PINK SLIPS BLOSSOM IN HIGH-TECH LAND

The semiconductor industry has been the hardest-hit segment of the electronics industry—so far. Now, however, equipment vendors are starting to lay off workers by the thousands. Many companies have instituted big layoffs in the past six months:

- **Intel Corp.**, Santa Clara, Calif., let 900 people go in February. The firm now employs 24,200 and doesn't anticipate shorter work weeks.
- **Advanced Micro Devices Inc.**, Sunnyvale, Calif., has maintained its no-layoff policy and tempered a two-week mandatory vacation beginning June 24 with the release of profit-sharing funds that average two weeks' pay for each employee. However, it plans additional shutdowns in the form of four-day work weeks lasting for 12 weeks starting July 8.
- **Motorola Inc.,** Phoenix, Ariz., is implementing a "voluntary" layoff plan that provides people with severance pay if they leave their jobs. The company also has a work-sharing program that gives workers in Arizona the option of filing for unemployment compensation for mandatory time off. Motorola will close its Austin, Texas, plant for the first week of July, giving most workers there a forced vacation.
- **Mostek Corp.**, Carrollton, Texas, a subsidiary of United Technologies Corp., has cut its worker rolls to about 6,000, having laid off 3,760 at sites from Ireland to Southeast Asia.
- **Texas Instruments Inc.**, Dallas, which employs 85,000 worldwide, has trimmed 3,000, primarily by laying off workers from its domestic semiconductor staff and by providing early-retirement incentives. It has also implemented a two-week shutdown around the July 4 holiday. Some operations were shut for two additional weeks in May and June and some plants are running on short work weeks.
- **National Semiconductor Corp.**, Santa Clara, which employs 37,000, has had 20 days of plant closings this year and has laid off 1,300. "Layoffs are always a last resort," says president Charles E. Sporck. "Unfortunately, the reality is that semiconductor market conditions have not shown significant improvement for the past year."
- **AT&T Information Systems** earlier this month cut 1,650 employees, although it denies any connection between this move and the slump in the personal computer market.
- **Memorex Corp.**, Santa Clara, will have about 4,500 U.S. employees affected by a two-week shutdown at the start of July. It also laid off about 200 in April because of a restructuring.
- **Honeywell Inc.**, Minneapolis, has laid off only 120 workers, but it has four separate one-week plant shutdowns scheduled for the year. Closings in April, May, August, and December affect 4,000 employees.
- **Control Data Corp.**, Minneapolis, has laid off 2,000 since the beginning of the year, bringing employment to 52,000.
- **Magnetic Peripherals Inc.**, a joint venture of CDC, Sperry, Honeywell, and the Bull Group, will idle 2,000 employees during a two-week shutdown in July.
- **Verbatim Corp.**, Sunnyvale, which laid off 400 in February, said last week that 200 more would be let go throughout the summer as a result of slow sales.
- **Dataproducts Corp.**, Woodland Hills, Calif., has cut its January employment level of 5,700 by laying off 1,300; another 300 are expected to be lost from the rolls.
- **Miniscribe Corp.**, Longmont, Colo., is moving nearly all its manufacturing to Southeast Asia. Where it once employed 1,000 in Colorado, it now has 400.
- **Tandon Corp.**, Chatsworth, Calif., laid off 370 in May and closed a printed-circuit-board plant in Simi Valley, Calif.
- **Wang Laboratories Inc.**, Lowell, Mass., has laid off 1,600 employees since June 5. Seeing its first quarterly loss in 12 years, the company also has instituted a mandatory two-week vacation at the beginning of July.

–E.B.

INTERNATIONAL TRADE

SIA PROTEST MAY NOT STEM TRADE TIDE

Tokyo

The unfair-trade complaint against Japan filed in mid-June by the Semiconductor Industry Association has touched off a series of emotional reactions in Japan. The issue was high on the agenda as U.S. and Japanese trade officials last week huddled for the fourth time this year over how to improve U.S. access to Japanese markets, particularly electronics. Cool-headed observers question whether the complaint and the brouhaha surrounding it will do much to stem the growing U.S.-Japan trade deficit in semiconductors.

The past efforts of Japan's Ministry of International Trade and Industry, the U.S. Trade Representative, and the Department of Commerce to open up the Japanese market to American goods "have been a failure," said SIA counsel Alan W. Wolff, a partner at the Washington law firm of Dewey, Ballantine, Bushby, Palmer & Wood, in Tokyo for the meetings.

One problem, he says, is that "Americans have clearly been kept in the position of residual suppliers. They are the last asked to participate and the first asked to depart." The other problem is that "the Japanese makers are selling in the American market for below the cost of production. That is dumping, that is unfair."

Attention getting. Most of the U.S. semiconductor industry rates the SIA's action worthwhile, at least for getting attention. Of course, MITI sees it differently. Expressing surprise at the SIA action, a spokesman termed it "counterproductive" for U.S. firms seeking to gain greater access to the $8 billion Japanese semiconductor market.

Yoshihiko Sumi, deputy director of MITI's Industrial Electronics division, said it was ironic that the SIA would file the complaint after dropping the U.S.-Japan High Tech Working Group last September. "Rather than blaming each other, we should make our objectives positive ones based on fact finding," Sumi continues.

Both Hitachi Ltd., which was recently accused by the Commerce Department of dumping memory chips on the U.S. market, and Fujitsu Ltd. declined to comment on the SIA complaint. The two firms, along with NEC Corp. and Toshiba Corp., were named in the complaint as companies directly benefiting from restrictive Japanese trade policies [*Electronics,* June 17, 1985, p. 13].

The complaint, filed under Section 301 of the Trade Act of 1974, calls for open negotiations with the Japanese to ensure "a prompt and dramatic improvement in U.S. sales in Japan"—now estimated by the SIA to be 10%—and an end to alleged Japanese dumping of semiconductors on the U.S. market. As an interim goal, the SIA suggests that the U.S. share of the Japanese market should equal Japan's share of the U.S. market by 1986.

Although he declines to comment on

the SIA complaint until the Reagan Administration takes formal action, Mitsuaki Sato, president of the Japan External Trade Organization (Jetro) in New York, disputes the SIA's market-share estimates. To calculate the U.S. market share in Japan, Sato asserts, U.S. manufacturing facilities in Japan as well as in South Korea and Taiwan must also be included. When these sources are added to the SIA estimate of 10%, he explains, the U.S.'s market share increases. "According to our calculations, the U.S. holds a 19% share" of the Japanese semiconductor market.

An SIA spokeswoman at its San Jose, Calif., headquarters responds that its estimate includes U.S. merchant manufacturers operating in Japan, Korea, and Taiwan but excludes captive manufacturers there, most notably IBM Japan. "We feel that our calculations are correct," she concludes.

Though the complaint points out the growing sense of urgency over the U.S. trade deficit with Japan, says Thomas Kurlak, a semiconductor industry analyst with Merrill Lynch, Pierce, Fenner & Smith Inc., "it appears what [the SIA] really wants is protection here" in the U.S. However, he continues, "The chances of a major success in Japan are already low."

Still, Kurlak and others agree with the SIA that the dumping of Japanese chips such as erasable programmable read-only memories [*ElectronicsWeek*, June 10, 1985, p. 11] must end. Kurlak says the practice—which the Japanese have denied—is "materially damaging the U.S. semiconductor industry."

Call for action. "Clearly something needs to be done," agrees James A. Barlage, who follows the chip industry for Smith Barney Harris Upham & Co. "Something should have been done two or three years ago." Barlage, who estimates the U.S. market share in Japan at only 8%, believes the complaint will make electronics a "front-burner issue" at trade talks but adds, "I'd be surprised if Reagan took any action."

Emphasizing that Japan's share of the U.S. market has jumped from 5% to 17% over the last five years, Daniel L. Klesken of Montgomery Securities in San Francisco characterizes the complaint as a "tourniquet action instead of a permanent fix." Klesken adds: "It's a plea on behalf of [the semiconductor] industry to Washington saying, 'We don't have a trade policy.'"

Klesken suggests higher U.S. import duties as one way of putting some teeth into the negotiations between the U.S. and Japan. With tougher measures in place, he maintains, U.S. firms could grab as much as 20% to 30% of the Japanese market.

–George Leopold and Jonathan Joseph

MEMORIES

EPROM PRICES DIVE TO LESS THAN $5

Palo Alto

There was a time when U.S. chip makers believed the erasable programmable read-only memory was a product they could count on for profits. But now Japanese suppliers have roared into the market and EPROMs are selling for less than a third of the price U.S. firms expected only a few months ago.

In January, distributors and chip makers agree, 256-K EPROMs cost $20 each in 10,000-piece lots. The price dropped to $8 in March, and today it is under $5. A Silicon Valley retailer, who sells both semiconductors and shaving cream, offers Intel Corp.'s 256-K EPROM in a ceramic package for $8.79, quantity one.

No surprise. The owner of the store won't say where he gets the chips, but the price comes as no surprise. One executive whose firm makes EPROMs says prices "fell off a cliff" last January, after a two-year decline that started slowly during the design-in phase and worsened when first production came in 1984 (see chart).

"That's when the Japanese started volume production," he adds. "A more normal present price would be around $13."

U.S. chipmakers are pulling no punches in accusing Japanese firms, particularly Hitachi Ltd., of buying the market with aggressive price competition. "The market just collapsed; whatever you quote, you don't get the business," says Stephen Zelenczik, senior vice president for sales and marketing at Advanced Micro Devices Inc. "It's the Hitachi 10% solution." He refers to the memo, since disavowed by Hitachi, in which salespeople were instructed to quote prices 10% below those of U.S. suppliers [*ElectronicsWeek*, June 10, 1985, p. 11].

Along with disavowing the memo, Hitachi denies that it is dumping. Harry McGrath, marketing communications manager for the firm's U.S. subsidiary, maintains that "our EPROM prices are not the lowest on the market." And he adds, "In fact, average EPROM prices in the U.S. are higher than in Japan."

Regardless of who started the war, the identity of the price leader no longer matters, according to Josh Napua, executive vice president for the electronics marketing group of Wyle Laboratories, an El Segundo, Calif., distributor. "AMD and Intel have both made it very clear that they don't intend to lose market share to the Japanese," Napua says. The result is a buyer's paradise.

There is a limit. Zelenczik, however, claims that AMD is willing to draw the line. "We are aggressive, but there is a limit," he says. "We have walked away from business. There comes a time when it's not worth it." AMD, he says, will hunker down (it has announced a series of belt-tightening procedures, including a two-week shutdown) and turn to 1-Mb and 512-K EPROMs, whose prices are still holding firm.

AMD is beginning to beat the drums for the idea, first advanced by Hewlett-Packard Co. founder David Packard in March and later picked up by AMD president W. J. Sanders, of putting a quota on Japanese imports set at a level that matches U.S. exports to Japan.

Intel is also studying the idea of quotas, says counsel Thomas Duncan. In addition to backing the Semiconductor Industry Association's complaint to the Commerce Department about unfair Japanese trade practices (see story, p. 23), Intel is considering some action on its own, such as an antitrust complaint to the Justice Department or a request to Commerce for quotas like those enjoyed by the auto industry, Duncan says.

–Clifford Barney

HOW PRICES FOR 256-K EPROMS HAVE FALLEN

	Date	Price in dollars	Quantity
Normal learning curve	First quarter 1983	150	Tens of units
	First quarter 1984	80	Tens of units
	First quarter 1985	20	Thousands of units
Abnormal pricing	March 1985	8	Thousands of units
	June 1985	5 – 7	Thousands of units

DIGITAL SIGNAL CHIPS GO SEMICUSTOM

Colorado Springs

Large-scale semicustom digital signal processors are about to invade the commercial chip market.

Honeywell Inc. will woo customers with chips based on its work for the Defense Department's Very High-Speed Integrated Circuits program. Also moving ahead is AT&T Bell Laboratories, which continues its internal work on both general-purpose and application-specific DSP products as AT&T's commercial-chip managers map out an assault on the growing signal-processing market.

Both of these efforts indicate a trend toward application-specific DSPs. Akin to today's standard-cell logic activities, application-specific DSP ICs are exactly tailored to each customer's system and algorithms.

The result can be much higher performance from a smaller monolithic circuit, eliminating the need to send signal-processing data off chip. As in conventional standard cells, the application-specific DSP movement is expected to gain strength as computer-aided design and simulation tools make their way onto engineering work stations.

Great approach. "I think the application-specific DSP approach is a great one," says analyst Will Strauss, who closely tracks developments in the business for Forward Concepts in Tempe, Ariz. "Lately, I have been hearing a lot of interest among DSP users in application-spe-cific ICs. Until now, it has simply not been there."

In Colorado Springs, Honeywell is readying a facility to transfer its successful Phase 1 VHSIC experience into commercial DSP products. It expects to ship its first CMOS application-specific chips before the end of the year.

In addition, Honeywell's Signal Processing Technologies venture group is also using the same semicustom CMOS library of 1.25-μm standard cells and complex DSP-oriented macrocells to piece together standard products for introduction in the first quarter of 1986.

Under Phase 1, Honeywell employed a similar macrocell-design methodology to create 1.25-μm bipolar circuits for its electro-optical signal-processing chip set. The three VHSIC components it produced—a sequencer, arithmetic address generator, and parallel programmable processor—are now being designed into military systems by U.S. defense contractors. Today, the three-layer-metal bipolar library has about 35 large macrocells, including bit-slice processors, sequencers, multipliers, 2-K blocks of random-access memories with 8-ns speeds, and 80-K sections of read-only memory. The internal gate delay of the bipolar macrocells is 300 ps.

Growing library. The growing CMOS library currently has 10 DSP-oriented macrocells, including a 16-by-16 multiplier, bit-slice processors, sequencers, floating-point arithmetic logic units, register files, first-in/first-out circuits, 24-K ROM blocks, and 4-K RAM with 15-ns access times. The number of CMOS macrocells—which have internal gate delays of 0.5 to 1 ns—are expected to more than double by year end.

Honeywell's design system—based on development work performed under VHSIC—also contains about 60 standard-cell logic blocks representing conventional small- and medium-scale logic functions. "The macrocell movement is definitely coming, but it will not come completely into its own until you are talking about processing technologies in the 1-μm range," states Pat Narendra, business director of DSP products.

Both the bipolar and CMOS DSP chips will be fabricated in a recently completed facility for 6-in. VHSIC-class wafers. The Colorado Springs plant is now being fully equipped for production later this year. The DSP processing technology actually yields minimum CMOS feature sizes of about 1 μm using 1.25-μm lines projected from photolithography equipment. Furthermore, the process produces small metal pitches, with line and spacing approaching 1 μm.

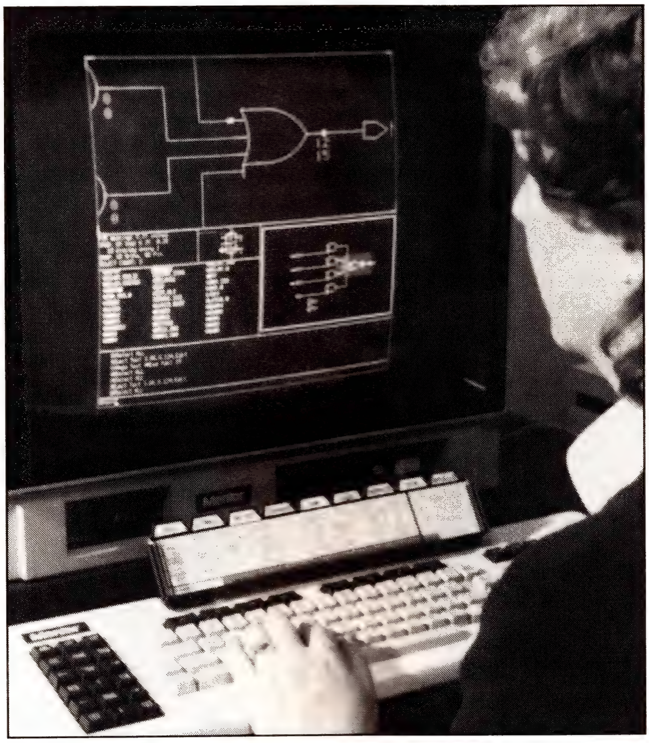
This allows Honeywell to pack several complex DSP macrocells onto a single chip along with the necessary glue logic, on-board memory, and interconnect lines (see photo, p. 26). The application-tailored DSP components will have as many as 30,000 to 50,000 transistors on a die. Narendra says a 16-by-16 multiplier (consisting of 4,000 gates) will fit on less than 20% of a die approaching 400 mils on a side.

A number of standard-cell vendors are now offering bit-slice processors and multipliers in CMOS libraries, but Narendra maintains standard 2-to-3-μm processing technologies are unable to place all the needed functions on a single DSP chip. Keeping all the signal-processing blocks on a single chip provides higher speeds because there are no off-chip delays. It further lessens the complexity of DSP algorithms because pipeline registers do not figure into the processing overhead, he adds.

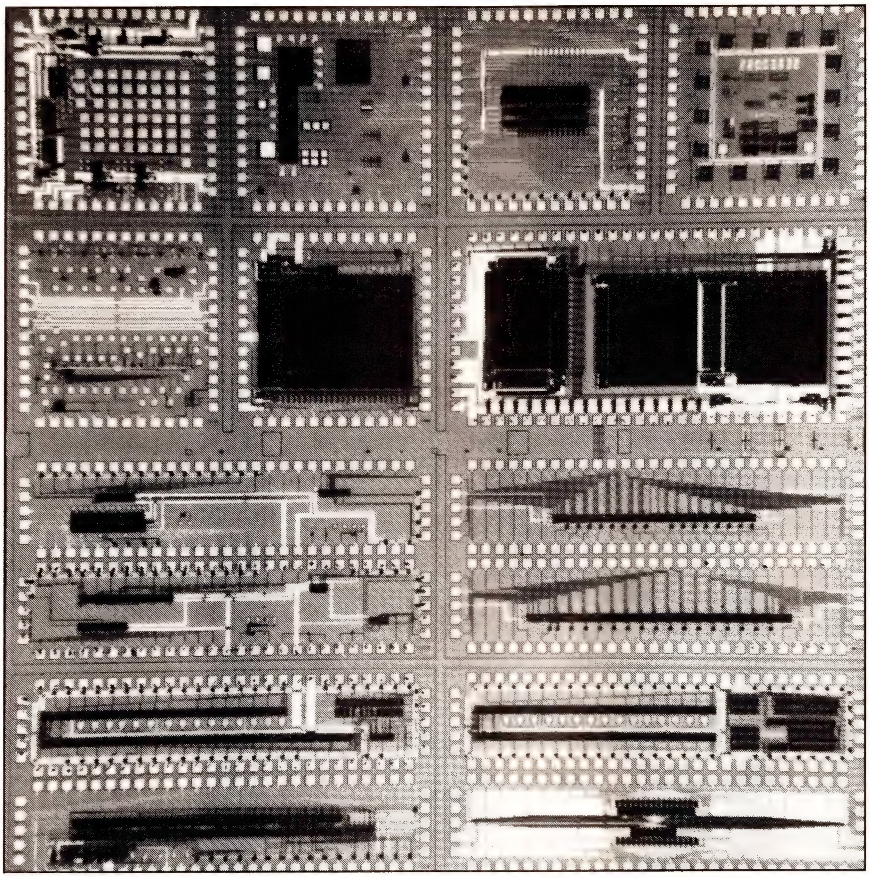
Perhaps the biggest advancement, however, is Honeywell's DSP design system, which blends the use of fixed-dimension standard cells and "flexible" VHSIC-class macrocells. The CAD methodology automatically splits open macrocells whenever more routing paths are needed, keeping the die smaller and interconnect delays at a minimum.

The front-end design-capture portion of the CAD system is now being placed on commercial work stations. Automatic-placement and routing software is executed in Colorado Springs on a Honeywell DBS88 mainframe. (Placement for the DSP macrocells is done manually; routing is done automatically. Placement and routing of the simpler standard cells are both done automatically by the mainframe.)

The turnaround time on DSP designs is expected to be six months when the operation is in full production. "We are



Large library. Honeywell's custom approach creates a macrocell library of commonly used components, such as arithmetic logic units, multiplexers, and random-access and read-only memory units.



Tight quarters. Honeywell's new DSP technology yields minimum CMOS sizes of about 1 μm, and spacing that approaches 1 μm, so several complex DSP macrocells can fit on one chip.

looking to drive DSP custom-chip development costs down into the couple-hundred-thousand-dollar range. A year ago, with the VHSIC efforts you were talking about $1 million to $5 million per chip," Narendra says.

In the future, Honeywell also plans to combine some npn bipolar circuits on CMOS chips. "We have found that useful when you are doing special-purpose analog functions combined with digital circuits on the same die," he says, referring to Honeywell's BMOS (bipolar-enhanced MOS) process disclosed at last month's Custom Integrated Circuit Conference in Portland, Ore.

AT&T's plans. Semiconductor officials of AT&T Technologies are now formulating plans to enter the commercial DSP fray. Since the late 1970s, Bell Labs has been developing digital signal-processing products for internal use in AT&T's military-system applications. W. Patrick Hays, supervisor of DSP design at Bell Labs in Holmdel, N.J., says design-automation systems have been used in recent years to create application-specific chips, but emphasis remains just as heavy on programmable general-purpose processors.

Programmable chips are easier to debug than tailored silicon solutions, he notes, and the high volume of general-purpose chips leverages long-running production runs against the cost of fine-line processing technologies.

"Still, I would have to agree that the balance is shifting gradually in favor of application-specific designs with CAD advances being the change in the equation," Hays adds. Bell's DSP chips—including the newest general-purpose 32-bit product, made from 1.5-μm n-MOS and capable of performing 8 million floating-point operations per second—are being used in AT&T telecommunications, speech analysis, speech synthesis, and voice-recognition applications. No date has been set for AT&T's planned entry into commercial DSP chip markets. *–J. Robert Lineback*

SATELLITES

LANDSAT OPERATORS SEEK $250 MILLION FEDERAL SUBSIDY

Washington

Attempts to revive the foundering Landsat satellite system shifted to Capitol Hill in mid-June as the system's current and former operators made their case for a $250 million government subsidy to develop two satellites and to build a new ground station.

Summing up the attitude of most lawmakers at a hearing before the House Committee on Science and Technology, Rep. Bill Nelson (D., Fla.) maintained that the transfer of Landsat to the private sector marks "the beginning of a new space industry." Although some committee members question some aspects of the agreement between the Commerce Department and Earth Observation Satellite Co. (Eosat) announced last month, chances for House passage authorizing the subsidy were pretty good, said a committee source. The Senate Commerce Committee has already approved a $295 million authorization bill for Landsat commercialization and the Office of Management and Budget has dropped its opposition to the transfer [*ElectronicsWeek,* May 27, 1985, p. 14]

Ten-year program. Under the deal, as Eosat president and chief operating officer Charles P. Williams testified, his company will take over operation of the Landsat 4 and 5 systems and deploy Landsat 6 and 7. For the latter, their thematic-mapper instruments—enhanced multispectral scanning devices that provide digitized, seven-band pictures with 30-meter resolution—will be upgraded to improve the resolution of the black and white scanning band to 15 m.

A new on-board processor would allow thematic-mapper data to be compiled on a larger scale. Each satellite would have a five-year design life.

Landsat's photographs of the Earth's surface are used to forecast crops and locate mineral deposits. About 25% of its data is purchased by government agencies while the bulk of the remainder is used by firms involved in oil, natural gas, and mineral exploration.

The proposed ground station would improve the system's data-processing capability from the current rate of 13 scenes per day to 50 scenes. For smaller end users, processing of partial scenes would be possible, according to Warren D. Nichols, a vice president of Hughes Aircraft Co., one of the partners in the satellite project.

The commercialization of Landsat stems from the passage last June of the Land Remote Sensing Commercialization Act. Since then, the Commerce Department has been negotiating to transfer the system to the private sector. Eosat, an Arlington, Va., partnership formed by Hughes and RCA Corp.'s Astro-Electronics Division, was recently selected over six other firms, including runner-up Eastman Kodak Co., to take over the satellite system operated by the government since 1972. Hughes will manufacture the sensors while RCA will design and build the spacecraft.

Williams stressed "the importance of immediate program implementation and the potential erosion of U.S. leadership in remote sensing," referring to French and Japanese satellite programs that Williams described as "heavily subsidized." The launch of the French Spot Image system is planned for October [*ElectronicsWeek,* March 25, 1985, p. 25].

The hearing ostensibly was held to determine whether the Landsat transfer represented a good deal for the American taxpayer. Anthony J. Calio, deputy administrator of the National Oceanic and Atmospheric Administration, Landsat's former operator, testified that Eosat will fund all capital costs over $250 million.

"We are confident there is no situation in which the [Reagan] Administration would come to you for any additional funding for this contract," he told the committee.

Because of stiff foreign competition, "Eosat is going to be in a very tough marketing position," Rep. Robert Walker (R., Pa.) maintained at the hearing. But Calio responded, "The partners believe there is a potential market for remote sensing." *–George Leopold*

COMPUTER-AIDED DESIGN

COMPETITION BUILDS TO SPEED LOGIC SIMULATION

St. Paul, Minn.

This week's Design Automation Conference in Las Vegas promises to offer hope to engineers searching for ways to crack the design bottlenecks imposed by such computation-intensive tasks as logic and fault simulation. A trend toward more application-specific hardware accelerators to meet those needs picked up speed at the recent Automated Design and Engineering for Electronics show in Anaheim, Calif. [*ElectronicsWeek,* March 11, 1985, p. 20]. That trend looks certain to continue in Las Vegas.

A number of new hardware accelerator packages are set for introduction at the DAC by work-station-systems vendors including Valid Logic Systems Inc. and Cadnetix Corp. But one of the hottest debates might come at the high end, where the processing capabilities claimed by the vendors will reach a level of millions and even beyond a billion events per second. By contrast, most conventional software-based logic-simulation packages run at speeds of only 2,000 to 4,000 events/s.

Until now, the extreme high-end realm of commercially available hardware logic simulators has been exclusively the domain of Zycad Corp., a four-year-old Control Data Corp. spinoff [*ElectronicsWeek,* Feb. 25, 1985, p. 44]. The St. Paul company has held sway in the market with its LE-1000 series, built with supercomputer design expertise that was born at Control Data. Since the LE-1000 was introduced in 1982, the system's unmatched capabilities have made it a popular item among sophisticated users with very large simulation needs. Zycad has sold multiple LE-1000 systems, for example, to customers including Digital Equipment Corp., Data General, and Texas Instruments, among others.

Off-the-shelf contender. But at the DAC, Zycad will lay eyes on at least one new challenger, and the confrontation will pit the power of custom very-large-scale-integration circuitry against Zycad's approach of using largely off-the-shelf components in its proprietary, pipelined, highly parallel designs.

The new entry is three-year-old Silicon Solutions Corp. With limited production planned for December, the new Mach 1000 Logic and Fault Simulation Engine from the Menlo Park, Calif., firm is based on a design using a set of 10 custom VLSI chips fabricated in high-performance MOS, and each integrating some 20,000 transistors, says product marketing manager Russell B. Hall. The result, he contends, will be price-performance figures that will beat Zycad's.

Like Zycad's LE-1000 line, Silicon Solutions' new product will take a modular approach. offering the Mach 1000 in versions containing from 1 to 32 processing boards. At the top end, the 32-board Mach 1000 will play in the same league as Zycad's LE-1032 by offering 15-million-events/s processing on designs of up to 2 million gates. The 32-module Zycad system, by contrast, crunches 16 million events/s on up to 1.6 million gates.

Prices for the top end of the Mach 1000 line are not yet firm, but will be set to beat the LE-1032's $2.1 million price tag, Hall assures. What's more, he contends that for some low board-count configurations, the Mach 1000 will offer

GETTING SIMULATORS ON THE ENGINEER'S DESK

After establishing itself as the premier vendor at the high end of the market for dedicated-hardware logic- and fault-simulation systems, Zycad Corp. of St. Paul, Minn., will shift downward to the engineer's desk with the introduction of two new low-end products at this week's Design Automation Conference in Las Vegas.

One system, known as the Expeditor, is a turnkey logic- and fault-simulation package designed to be shared by engineers working on a network. Set for first deliveries next month, the Expeditor series will come with a complete software package to be connected with various host systems, including the IBM Personal Computer AT, DEC's VAX and Microvax, AT&T 3B2, and Apollo lines.

The Expeditor hardware simulator will be offered in two versions: one system, priced at $95,000, will offer 25,000-gate logic-simulation capacity at speeds up to 1 million events per second; the second, priced at $125,000, will provide 50,000-gate capability at the same speed.

The new Expeditor package is expected to provide strong price-performance competition for the low end of the forthcoming hardware-based accelerator line from Silicon Solutions Corp., also set for introduction at the conference. The accelerator line, the Mach 1000 Logic and Fault Simulation Engine, in its smallest, one-board configuration will provide a 65,000-gate capability with processing rates of 500,000 events/s and is priced at $85,000 for logic simulation only. The addition of fault-simulation capability to the low-end Silicon Solutions system raises the price to $150,000.

The second new Zycad offering is a board-level system that can be plugged into any Multibus-1-based engineering work station or personal computer to add hardware-based logic- and fault-simulation capability. The Sprintor package will be offered only to original-equipment manufacturers and is scheduled to begin shipping during the first quarter of next year.

The Sprintor will do logic simulation for designs up to 25,000 gates at 200,000 events/s, says Zycad product marketing manager David W. Allenbaugh. OEM prices have not been specified. But the Sprintor package, when integrated, is expected to cost the end user from $15,000 to $25,000, positioning it against the offerings of several work-station vendors. **–W.R.I.**

the same capabilities for a fifth of the cost of the Zycad LE-1000 line. Algorithms embedded in the Mach 1000 hardware are based on Cadat simulation software supplied by HHB-Softron of Mahwah, N.J.

Both ends of line. But just as Silicon Solutions is preparing its leap into the market, Zycad is countering with new product announcements of its own at both the high end and the low end of its line (see "Getting simulators on the engineer's desk," p. 27). Last month, Zycad said it will raise the stakes even further early next year when it plans first deliveries of a new accelerator product known as the System Development Engine (SDE). To be specified at a blazing 1 billion-plus events/s for logic simulation of up to 1.5 million gates, Zycad says the system will for the first time allow a designer to simulate an entire electronic system, including software, before going to prototype hardware. Tentative pricing is set at $2.5 million.

"I'll believe it when I see it," responds Silicon Solutions' Hall of Zycad's SDE plans. "There's significant engineering risk to whatever their approach is on that one."

But for Zycad's part, product marketing manager David W. Allenbaugh says that "much of the nitty-gritty design work [on the SDE] is all done. We've checked out the algorithms and I'm confident we can meet those numbers." He also points out that Zycad is not only moving at the top end to maintain its leading market position, but will also compete with the low end of the forthcoming Silicon Solutions line with its two new systems. *–Wesley R. Iversen*

ROBOTS

NOW IT'S KOREA'S TURN IN THE ROBOT MARKET

Seoul

Americans may make innovative robots and the Japanese may make the most robots, but the Koreans appear to want to make the cheapest robots.

Daewoo Heavy Industries Ltd., a member of the giant Daewoo Group of Korea, recently began marketing an arc-welding robot for 20% to 30% less than equivalent robots being sold by Japanese and U.S. companies. Daewoo claims that this is the first made-in-Korea robot. It was designed by Young-kook Kang, a Korean native who returned after helping to design the navigation and control subsystems for the National Aeronautics and Space Administration's space shuttle and is now executive managing director of Daewoo Heavy Industries.

The Nova 10 welding robot has a five-axial rotating arm (a sixth axis is optional), driven by a dc servo motor, and boasts a rotation of 150° at a speed of 96°/s. It has five central processing units, four 16-bit 68000 microprocessors, and one 8-bit Intel 8050 chip driven by two software packages—one for arc welding and another for palletizing, or material handling. The Nova 10 can be adapted to use arc sensors and other vision sensors. The maximum load capacity is 10 kg, and the arc welding apparatus has a repetitive positioning accuracy of 0.2 mm.

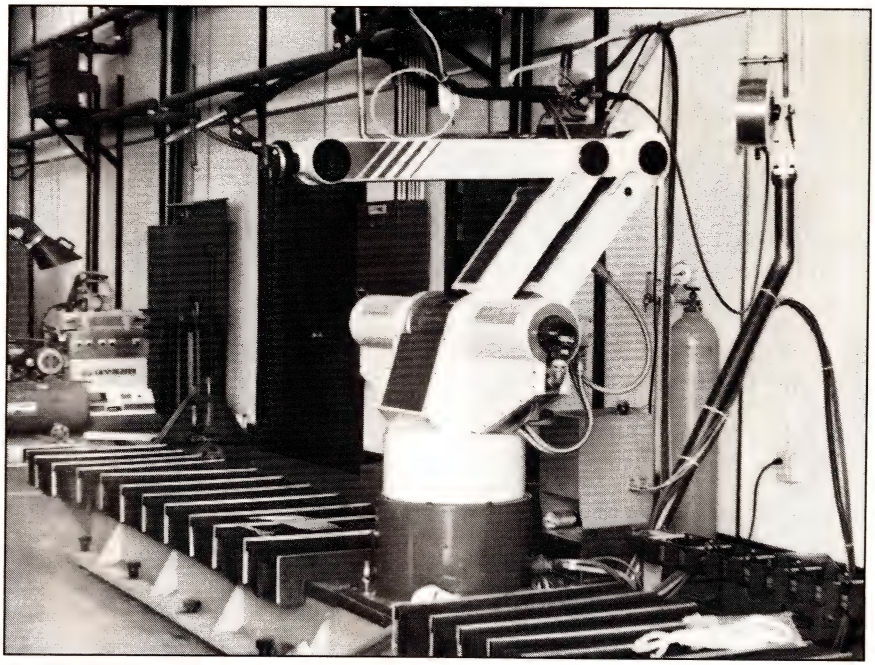
Nothing new. None of this, of course, is new to the world. Yaskawa Electric Manufacturing Co. in Japan (which has ties with Hobart Brothers Co. in the U.S.) offers its Motoman-L10W, a five-axis welding robot of similar size. The Yaskawa machine has 90° more rotation and about the same upper-arm and lower-arm mobility, and, driven by two Intel 16-bit CPUs, it has a larger programming capacity as well as 3-d and mirror-image shifting functions. It retails for $28,000. Though Daewoo refused to reveal the list price for its Nova 10, Kang did say it was competitively priced with the Motoman.

Despite competition from more sophisticated, albeit more expensive, Japanese and American robots, the Daewoo robot managed to excite some interest at the Robots 9 conference held in Detroit early this month, says Kang. The two models Daewoo brought to the show were "sold on the spot" to firms in the automotive support business, he says. Kang was reluctant to reveal prices or predict unit sales this year, but a Daewoo spokesman did say that the firm could be exporting the robots by the end of the year.

The Daewoo Group, founded only in 1967, is the youngest and perhaps most aggressive of the Korean *chaebol*, or conglomerates. Consolidated sales last year reached $5.12 billion (Daewoo Heavy Industries Ltd. had sales of $430 million).

Importance. The importance of the Daewoo robot is greater than the product alone: the machine signals a new stage in the development of Korean high-tech capabilities. Daewoo is apparently the first Korean firm to build a robot from scratch, without outside technical assistance. The firm began producing the robots a year ago and uses five in its own factory for producing railroad rolling stock and lift trucks. The company shipped its first unit in mid-June to the leading Korean steel concern, Pohang Iron and Steel Co., and just completed its first batch of 10 robots.

Daewoo is not the only Korean firm seeking to develop production robots. The Hyundai Group, the leading Korean automaker, formed an agreement last May to acquire robotics technology from the small Japanese firm, Nachi-Fujikoshi Corp., in Toyama City. Hyundai will install the robots it makes with Nachi know-how in its auto plants in Korea. Samsung also has also been working on



First born. Daewoo's new welding robot signals a new stage in the development of Korean high-tech capabilities. The company is the first Korean firm to build a robot from scratch.

developing an in-house robot, though it does not yet have a product to report.

It is ironic that Korea is turning increasingly toward capital-intensive labor-saving devices such as robots. The country is known for its average industrial-worker wages that are a third of those in Japan and less than a fifth of the $25 an hour that U.S. workers get. Yet Japan was in a similar position 17 years ago when it entered the robot market, and has since surged forward to become the world's leader in robot production. In 1984, Japan produced 27,000 playback and programmable robots, reports the Japan Industrial Robot Association in Tokyo. The U.S. produced about 14,000. By 1986, over 65% of the robots employed in Japanese industry will be insertion robots, used primarily in the electronics industry.

By putting in robots while wages were still low, the Japanese have been able to leverage a double advantage—lower wages and higher capital spending—against their U.S. competitors to achieve cost reductions that are unheard of in the U.S. and Europe. The Koreans may eventually do the same.

The development of a Korean robotics industry is inevitable, says Tony Moyer, a robotics industry analyst with W.I. Carr & Sons (Overseas) Ltd., in Tokyo. Daewoo, which he characterizes as ambitious, is moving broadly into heavy industry (it already has extensive electronics interests), and may in the future become an important competitor for the Japanese in the low end and middle of the robotics business. But in the high end, Moyer says, "The Koreans have a way to go yet." *-Jonathan Joseph*

VIDEO PHONES

SYSTEM HELPS DEAF 'SPEAK' ON PHONE

Colchester, England

The deaf can communicate in person by using a combination of sign and body language or by lip reading, but they are almost without resources when it comes to greater distances. Now help is on the way: Essex University's Department of Electrical Engineering has in operation an experimental video system for the deaf that runs over normal telephone lines.

A camera, screen, and—at the heart of the system—a clever video-compression system that works at 8 kb/s do the trick. The data rate is eight times lower than that of commercial video-compression systems. To be sure, the system does not provide full gray-scale images, but its cartoon-like pictures, similar to pencil sketches, do come through with enough clarity for sign language. And they come fast enough for communication at normal rates.

It is possible that conventional video-compression systems, transmitting gray-scale images, may one day be used for the deaf. But for the moment there are two snags. First, the gear is expensive. And second, the picture tends to smear as the "speaker" moves, a problem when trying to read sign language.

"It is so bad that when a user gets up, he can disappear altogether for a second or more," explains Don Pearson, who heads the Essex research. The reason: most compression techniques exploit redundancy in the image, transmitting only the difference from image to image. So when the picture changes suddenly, the electronics is caught short.

One solution is to transmit only the information needed to cue a deaf person. So the Essex setup sends only outline images, updated eight times a second. Pearson and co-researcher John A. Robinson have moved the technique another step nearer to practicality by turning a standard 625-line image directly into a black and white video signal. Because they are monochrome, images can be conveniently transmitted using the Group 3 facsimile protocols of the International Telephone and Telegraph Consultative Committee.

The Essex system employs a new image-processing algorithm and special-purpose hardware to run it. Early attempts at extracting image outlines have worked by detecting edges. That is simply done, but there are problems. "Features such as chins and noses do not project into edges and give double lines," explains Robinson. So the Essex researchers detect luminance valleys, which occur when a facial plane falls into the viewer's line of sight.

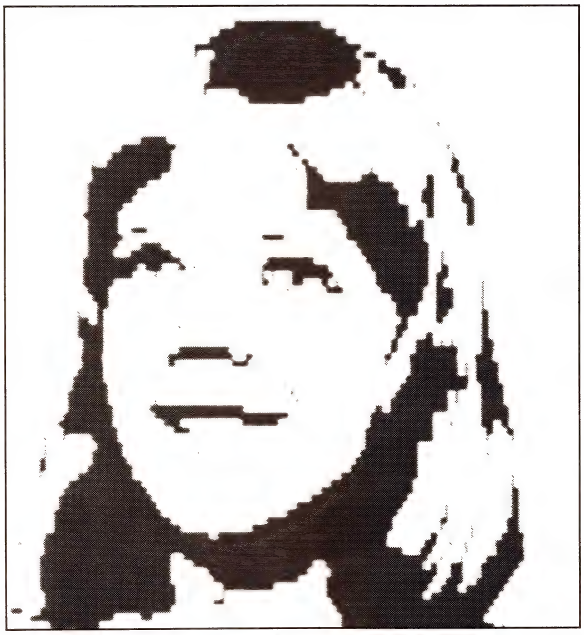
Pixels compared. With the Essex hardware, the TV image is first digitized using a 6-bit gray scale. Then it is scanned a pixel at a time by comparing neighboring pixels to see if any are significantly brighter. Results for each of the eight surrounding pixels are passed to a lookup table where the logic hunts for a minima. This process continues to build up a luminance contour line. The processing circuitry, built from static random-access memories and low-power Schottky logic, is heavily pipelined and can work in real time.

As yet, no effort has been made to actually transmit down a telephone line. However, trials with the deaf were first carried out in England at the Royal National Institute for the Deaf and the results were published in 1976. Since then, work has been pushing along simultaneously in Britain, France, and the U.S.

At Essex, the basic data rate in the lab is 4.8 to 9.6 kb/s, but when facsimile protocols are added, this would be increased somewhat. The technology, says Pearson, is still some years away from being marketed. A commercial setup, he says, would use a small, cheap, solid-state camera, a low-cost, 64-line, liquid-crystal display, a single-chip modem, and a data-compression circuit on a single chip. "It would have to sell for a couple of hundred dollars," Pearson estimates.

By then, too, systems of this sort could run on the Public Switched Telephone Network at 9.6 kb/s or on an ISDN link at 64 kb/s. Meanwhile, video conferencing service is advancing. Europe now has a 2-Mb/s standard, and plans are afoot to move to slower rates and therefore narrower bandwidths.

This possibility worries Pearson, because bandwidth can be reduced only by trading off temporal or spatial resolution. If temporal resolution, the effect that causes smearing, is too low, the deaf could be left behind by any new standards. *-Kevin Smith*



Getting the picture. Essex University's system compresses video signals to send over phone lines as cartoon-like images so deaf users can read lips or sign language on a screen.

THE FIRST PRACTICAL NON-VON NEUMANN COMPUTER IN FULL SWING.

NEC's NEDIPS—NEC Data-Flow Image Processing System—the world's first practical non-Von Neumann computer is performing well at a remote sensing technology institute in Tokyo.

NEDIPS was originally developed for processing image data from satellite-borne synthetic aperture radar. It has reduced processing time to about 3 hours from over 100 hours required by conventional mainframes.

Our data-flow computer features three advantages over sequential processing. First, system performance is virtually unlimited by memory input/output speed. Instructions are executed in parallel automatically. Programming and debugging are easy because it adopts a functional language.

NEDIPS, with a minicomputer like NEC's MS serving as a host computer, consists of an efficient data-flow processor and memory subsystem which is expandable to 64 Mbytes. Maximum processing speed is 159 MFLOPS. Superior speed and programming ease make the system highly suitable for diverse scientific calculations such as dynamics simulation and differential equations, signal processing and general image processing.

C&C
Computers and Communications

NUMBER 133

V20/V30 FEATURE EXTENSIVE CMOS PERIPHERALS.

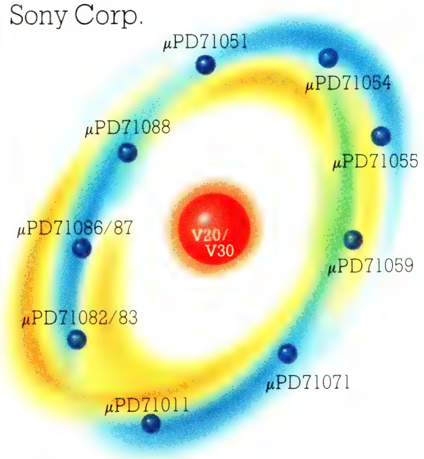
The first 16-bit members of NEC's V-Series CMOS microprocessor family are available with CMOS peripherals. The 8-bit external bus V20 and full 16-bit V30 fit into most existing systems and upgrade performance substantially.

The V20 and V30 feature dual data bus architecture and other hardware refinements to provide outstanding speed. The 101-instruction set includes bit operations, bit field operations, packed decimal operations and stack manipulations. Power consumption rates a low 300mW in operation and 50mW for standby.

Comprehensive CMOS peripherals complement CMOS V20/V30. A CMOS coprocessor (floating point processor) and advanced DMA controller are well under development.

System performance is further boosted with a multi-tasking Real Time OS. Development tools include an In-Circuit Emulator, Relocatable Assembler, Pascal and C compilers.

The V20 and V30 are to be alternately sourced by Zilog Inc., and Sony Corp.



LARGE-CAPACITY INFORMATION DISPLAY PAGER.

The new NEC D4α Information Display Pager packs state-of-the-art technology into a credit card-sized unit weighing only 100 g (3.5 oz).

It receives, displays, and saves a total of 12 messages up to a maximum total of 416 characters. The maximum single message length is 352 characters. Each message appears on the 5 × 7 dot matrix Liquid Crystal Display (LCD), 16 characters at a time. These features enable detailed messages or instructions to be communicated to the IDP user.

Up to eight current messages can be saved and recalled from the PORTAL memory. An additional four important messages can be selectively shifted to the VAULT memory, which protects them from being overwritten.

The two unique addresses assigned to each unit provide both information display and priority tone-only services to the users.

One of four optional alert modes is selectively programmed into each unit. The "Silent Secretary" mode delays received messages until it is convenient for the user to review them. Also, the number of messages received while in this mode will be displayed on the LCD. "Visual Alert", with a blinking red LED, displays and saves incoming messages in memory. "Quiet Alert" sounds a low-level alert tone. "Vibration Alert" blinks the LED and vibrates while it displays and saves incoming messages.

NEC TO SUPPLY FIVE EUTELSAT AND TWO SMS EARTH STATIONS.

As part of the European Communications Satellite (ECS) System, NEC is supplying earth stations for five member nations of the European Telecommunications Satellite Organization (EUTELSAT). Austria, Portugal, Switzerland and Turkey have ordered complete satellite communications systems, including TDMA/DSI (digital speech interpolation) terminal equipment. NEC has already supplied to Belgium a high-performance 18-meter diameter dish antenna and low-noise amplifier subsystems.

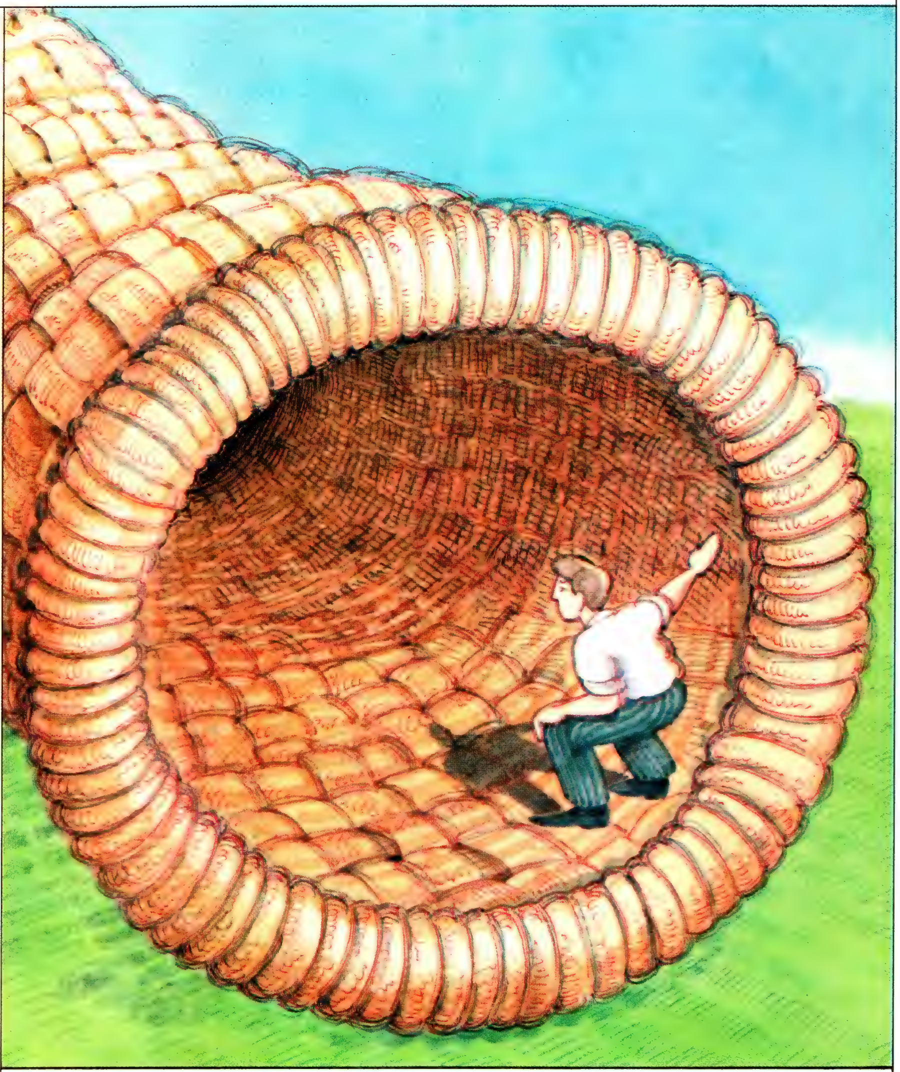
The latest digital technology will be used for telephone transmission to effectively use satellite transponders. The TDMA/DSI system will permit each station to transmit for a fraction of a second using the whole bandwidth of the transponder. The EUTELSAT series of satellites also forms a special network called the Satellite Multi-Service (SMS) System primarily for business users. NEC has also received orders for two SMS and two TV uplink earth stations from Norway.

NEC
NEC Corporation

BATTERED INDUSTRY LOOKS TO 1986 FOR SIGNS OF AN UPTURN

by the staff of Electronics

STYMIED BY A DRASTIC BUSINESS DROP ACROSS ALL SECTORS, U.S. COMPANIES ARE WRITING OFF THIS YEAR



With computer and semiconductor makers getting clobbered by one of the deepest business downturns in nearly two decades, the big question being asked by electronics industry executives is: when will their companies get back on the growth track? About the only answer now for most of them is that it won't be this year.

Buffeted by declining orders, the prospect of dwindling backlogs, and the stubbornly high level of the dollar against overseas currencies, U.S. executives are now starting to cut into their corporate muscle—they've already trimmed all the fat—to survive 1985.

Most of these executives have written off the final six months of the year, and look hopefully to a turnaround in 1986. "I think for the next 6 to 12 months, business will be tough—maybe longer," says Tom Ellis, U.S. marketing vice president at Texas Instruments Inc.'s Data Systems Group in Austin, Texas.

Businessmen in Western Europe and Japan, although not suffering to the same extent as their U.S. counterparts, know that their turn will inevitably come, as the slump in the biggest market in the world ripples over to their sides of the oceans.

Great expectations. To be sure, few executives six months ago thought that 1985 would be as strong a year as 1984, the first full year of economic expansion following the recovery from the recession of 1980-82. A record increase of 54% in the worldwide production of integrated circuits, for example, could not be matched. And indeed, the chip industry is now stagnating its way through one of the worst downturns in its nearly 40-year history.

But executives—and market researchers—did expect 1985 to be a strong year. And equipment vendors and component suppliers planned accordingly. They are paying the price now for their optimistic business plans. "It's a much more disappointing year than anyone foresaw," says a normally optimistic Charles Thompson, vice president and director of world marketing at Motorola Inc.'s Semiconductor Product Sector in Phoenix, Ariz.

As the U.S. economy moves through its third year of recovery and expansion, business momentum in general is slowing. The example of this most frequently cited by executives at electronics firms is that of capital spending.

A survey by the McGraw-Hill economics department in March and April found that corporations had cut their 1985 growth projections from just two months earlier. In January and February, U.S. companies planned to boost capital spending by 10.9%. In the later survey, this rate dropped to 9.9%.

One result: users of electronics products ranging from personal computers to communications equipment to test gear have drastically slowed down their purchases, causing the component pipelines to back up.

Another problem compounding the industry's problem, thinks one executive, were uncertainties on the part of potential customers about the Reagan administration's new tax plan. "There was a desire to wait and see what the tax plan would look like," says Richard L. Herander, senior vice president of finance at Intecom Inc., Allen, Texas, a pioneer private-branch-exchange maker that in March laid off 200 people.

With the plan out in the open, Herander is optimistic that this confusion may subside in the second half, causing a new wave of equipment purchases. "I believe we will see an increase in capital spending because people want to take advantage of the favorable benefits this year rather than deferring it to next and possibly losing it."

It can't happen soon enough for the beleaguered electronics industry.

SEMICONDUCTORS

CHIP SALES IN 1985 COULD FALL 25%

Anxious chip makers are beginning to fear that the much-scrutinized 1985 semiconductor business—the watched pot that so far has shown no signs of boiling—might never even make it to the lukewarm stage.

Semiconductor makers wait uneasily for end-equipment markets to show signs of an improvement that was expected to show up in the second quarter. "The buying public, whether business or individual, seems to be in a wait-and-see position relative to how it will use computers in the future," worries M. Douglas Rankin, vice president for worldwide sales at Signetics Corp. in Sunnyvale, Calif. "So much new equipment has come out in the past two years that people are having trouble absorbing it. It will sort itself out and start growing again, but for now we are in a plateau in computer shipments that will last some time."

With the second quarter ending, showing no improvements, befuddled silicon merchants expect sales to stay frozen at greatly depressed levels this summer while most of the electronics industry takes a respite during the traditional mass-vacation months. Two weeks ago, the Semiconductor Industry Association added the month of May to the casualties of a falling book-to-bill ratio. The much-watched business indicator resumed a downward path in May, hitting 0.72:1, compared with April's flat performance of 0.77:1.

Industry projections of 1985 worldwide chip sales now overwhelmingly expect negative growth in revenues from shipments, ranging from –2% to as low as –25% from 1984's record sales of nearly $26 billion. In the second quarter alone, the SIA now projects billings will be only $9 billion, 20% less than a year ago. In an *Electronics* poll of industry leaders this month, most indicate only two semiconductor segments are performing up to expectations: automotive and military business.

"A year ago, we still had great euphoria. We were shipping at all-time records," says Joseph van Poppelen, marketing vice president of National Semiconductor Corp. in Santa Clara, Calif. "Bookings had started down, but we figured that was an adjustment to backlog. We were at the peak of the wave. We had some suspicions, but our customers were belying them by accumulating inventory.

"I've been in this business for 31 years, and I have never seen anything as bad as this. It dropped off a cliff—percentage and dollars," he adds, echoing the dismay of many long-time semiconductor executives in the U.S.

Spending orgy. Almost to a man, industry leaders in the first half of the year stopped calling the 1985 slump "an inventory-adjustment period" and are now blaming low chip prices on the industry's orgy of capital spending and a glut of wafer-fabrication lines. The faltering personal computer business gets most of the blame for starting the slump, but chip producers report nearly all segments of equipment markets are taking fewer deliveries than anticipated. And now, the once-promising deregulated-telecommunications industry is beginning to show signs of a slide, notes Bruno Pagliuca, vice president and director of worldwide semiconductor marketing at Texas Instruments Inc. in Dallas.

Bad forecasts. Projecting a drop of 20% in total U.S. chip sales this year, Donald W. Brooks, president of Fairchild Camera & Instrument Corp., blames overcapacity on "some of the truly ludicrous forecasts going around the industry" that he complains "have dragged not only investors but companies and countries into this marketplace.

"A by-product is that capital investment is way out of line with revenue levels and growth rates that one would realistically anticipate. Now, we're faced with three to five years of surplus capacity, significant price pressures, and profitability problems in the industry."

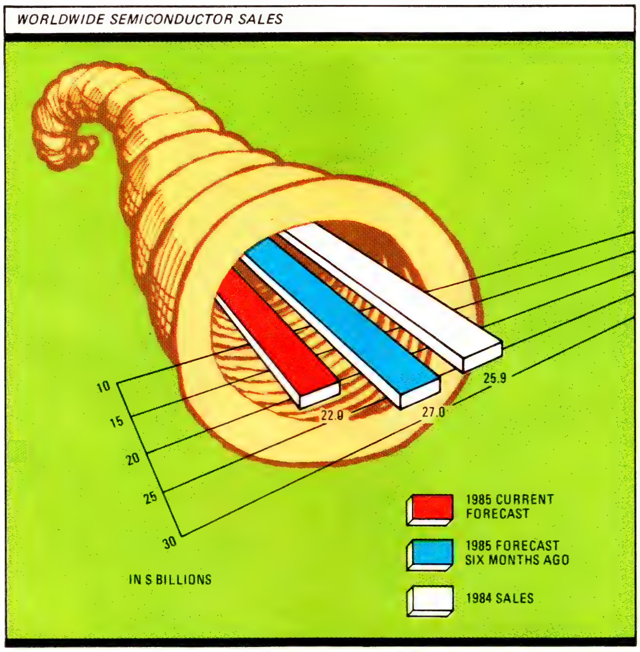
Overseas, semiconductor operations in Europe and Asia are feeling the impact of the tail-spinning sales and overbuilt capacity. A recent poll of Japanese firms shows producers optimistic for a fourth-quarter recovery leading to a general market upturn in 1986, based on assumptions of a stronger U.S. economic growth and new IBM Corp. Personal Computer products. But part of the hopeful scenario has been dashed with IBM's gloomy prognosis of a less-than-expected growth in the second half and rumors that it has postponed the introduction of the so-called PC-2.

Japan's Ministry of International Trade and Industry says the nation's integrated-circuit production is expected to register only slight growth in 1985. In the first three months of the year, Japan produced $1.92 billion worth of ICs, MITI says. In 1984, the figure was $7.43 billion, up 73.2% from 1983.

Exports of ICs from Japan, which totaled $3.17 billion last year, hit only $748 million in the first quarter. This projected annual rate of $3.0 billion reflects a negative growth for 1985, projects the nation's Ministry of Finance. Capital spending, which hit record levels last year in Japan, is expected to now show its first drop in eight years during 1985. NEC, Hitachi, and Mitsubishi have all said they will hold spending to 1984 levels, while Toshiba, Fujitsu, Matsushita, and Oki all plan cuts in 1985.

In Europe, semiconductor markets continue their traditional lag of other world mar-

WORLDWIDE SEMICONDUCTOR SALES



SEMICONDUCTORS IN A STEEP SLIDE

	1984 Sales	1985 Forecast six months ago	1985 Current forecast
	$ Billions		
Discretes	5.4	5.6	4.8
Memories	5.8	5.9	4.4
Processors	2.9	3.4	2.6
Standard logic	4.8	5.2	3.9
Semicustom/custom	1.67	2.3	2.2
Linear	1.36	1.5	1.0
Total semiconductor sales*	25.9	28.49 – 25.4	24.4 – 19.45

*Including all categories

SOURCE: *ELECTRONICS*

ket conditions by holding up generally stronger at midyear, report sources there. After near-record growth in 1984, European markets are expected to grow a mere 2% in 1985 from last year's $4.8 billion and to see a 16% recovery in 1986, according to Dataquest Ltd., based in London.

"We have only had two months where book-to-bill ratios have fallen below 1:1, but now it is back up again," maintains Melvin Larkin, technology director of Plessey Co. plc's Engineering and Components Division. "We are still planning for substantial growth but it is going to be tough to make budget," he says.

Part of Europe's strength is that the continent has had no major personal computer manufacturing base that has collapsed, as in other parts of the world, notes the Central Association for the Electrotechnical Industry, Frankfurt. Executives at Europe's biggest chip makers—Philips in the Netherlands and Siemens AG in Munich—think the industry downturn is only a temporary cycle.

But many U.S. chip makers see longer-term impacts in the sudden price collapse in such markets as memories and commodity logic. Englebert Kehren, strategic planning director at Mostek Corp. in Carrollton, Texas, says the actual bit usage of memory chips is up 80% over 1984, but "because of the excess inventory that was available, prices have dropped by more than a factor of four. So, if you look at the bottom-line dollar figure in the U.S., the market is going to be down between 15% to 20% in dollars." He expects prices to firm up starting in 1986, but excess capacity is a problem "we will have to face over the next couple of years."

COMPONENTS

NO SIGNAL THAT UPTURN IS COMING

If times are hard for makers of computers, instruments, and other electronics hardware, it figures they will be just as tough for the components manufacturers that supply the parts that go into them.

"Clearly, this year has not been anywhere as good as last year," says Frederick A. Krehbiel, executive vice president of Molex Inc., a Lisle, Ill., maker of terminals, connectors, and switches. "A year ago at this time, we expected to have a considerably better year than we've had," Krehbiel says.

For the firm's next fiscal year, which begins July 1, he says, "we're not expecting a banner year, at least for the first six months. Based on our backlog and order activity, we see no signs that it will be more than flat for the next six months."

Echoing these feelings is David M. Baker, vice president of marketing at Amphenol Products Inc., also in Lisle: "If there's going to be an upturn, we don't see it happening before the fourth quarter." Right now, he says, "it's very difficult to see any signals that there's an upturn coming."

Following a strong first half in 1984 and a slowing of the market in the second half last year, Amphenol had projected an upturn of about 10% for the first half of 1985 versus 1984's second half. "It hasn't turned out that way. Instead, business remains flat at the same depressed levels seen in last year's second half," says Baker. "Our major users are much off in their business and, correspondingly, our markets are flat."

Amphenol's commercial and industrial business serves areas such as computers and telecommunications, and "those sectors are not up to anybody's expectations," Baker observes. The bright spot is the military and aerospace connector business, which Baker says is "doing quite well and is above our forecasts for 1985," although he declined to say by how much.

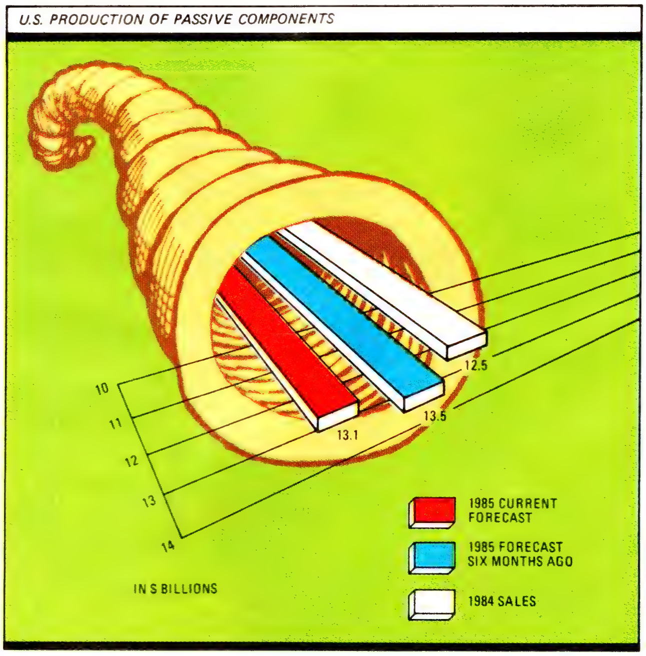
International business has held up better than domestic business, the Amphenol executive says. But even there, just in the last month or two, "we're beginning to see the kind of stagnation that we saw at the tail end of 1984 in the U.S." Baker notes hopefully: "We expect 1986 to be a better year than 1985. We hope the inventory glut that's had a profound effect on 1985 business will pass away by then."

On target. Some are taking the downturn in stride. "The midyear business outlook is right on target with my 1984 expectations," notes John Deith, vice president of sales at International Rectifier Corp.'s Crydom Division, a relay maker in El Segundo, Calif. "We expect a dramatic increase in business from now throughout 1986," as a result of expanded manufacturing capability and expected lower prices.

Unlike the majority of U.S. firms, the mood of components companies in Japan is optimistic, primarily because of strong demand from the domestic consumer electronics market. For example, production of video cassette recorders in Japan will grow this year to about 30 million units from last year's 27 million, even though exports are under pressure because of rising competition from Korean VCR makers. Japanese sales—in the U.S. especially—are facing downward pressure, thus exerting an indirect pressure on discrete production growth.

Production of discrete devices in Japan in 1984 totaled $2.49 billion, up 45% over 1983. But for the first quarter of 1985, production hit $583 million, up just 5.8% over last year's first quarter, according to the Ministry of International Trade and Industry.

U.S. PRODUCTION OF PASSIVE COMPONENTS



THE OUTLOOK KEEPS GETTING WORSE

Six months ago, computer makers believed they had it made in 1985. Annual forecasts agreed that the worldwide computer industry might chalk up very good growth in 1985. But with orders and profits sliding and merger talks blossoming amid a spate of plant closings, layoffs, shortened workweeks, and pay cuts, growth in many segments will be hard to achieve. Where there is growth, it will be lower than last year.

This cloudy outlook has a few bright spots, for example, most of the Western European market and companies either lucky or smart enough to be in a niche business. For most, though, the prospect of a brighter second half of the year is also not good, with little or no improvement expected.

The overall bleak picture comes from a consensus of views of industry executives in Western Europe, Japan, and the U.S. Nearly all the firms surveyed report a strong downturn in computer business.

Even industry leader IBM Corp., in revising its earnings outlook several times in recent weeks, points to a worsening situation for the rest of the year. In his most recent statement, IBM president John F. Akers said the company's profits in the first nine months of 1985 will likely not meet those of the same period last year and "we may have to reassess the fourth quarter as well." Yet earlier statements from IBM predicted a strong fourth quarter to pull the year's profits above last year's.

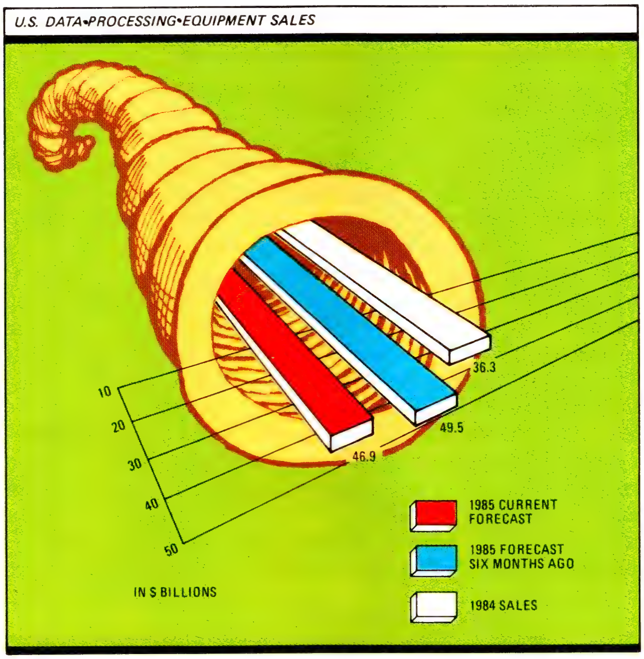
In Japan, the overall data-processing market also is cooling off sooner than expected. By all accounts, the market will show slower growth in 1985 than was previously predicted.

Late last year, the Japan Electronic Industry Development Association predicted a minimum annual growth of 25% in the data-processing market until 1989. However, the leading economic newspaper in Japan, *Nikkei Shimbun* (and its English-language weekly, *The Japan Economic Journal*), just completed a study that found only one Japanese company, Toshiba Corp., that will realize growth close to 25% this year.

Barry May, an analyst with W.I. Carr & Sons (Overseas) Ltd. in Tokyo, says Japanese data-processing companies have been overstepping themselves in their sales predictions, and suggests they may have to revise them. "Companies are putting out incredibly bullish forecasts. Too bullish," he says.

Japan's data-processing and peripherals markets are becoming increasingly linked to the U.S. market, notes Peter Wolff, vice president of Prudential Bache Securities (Japan) Ltd. "Whereas last year there was a lag of three months between changes in the American market and changes in Japan, now that gap is much less," says Wolff.

On the other hand, the European computer market is growing at a steady annual rate of between 12% and 15%, according to Groupe Bull, France's largest data-processing-equipment manufacturer. "The general market pattern really hasn't changed very much [since last year]," observes Gotz Völmer, Bull's director of customer relations. Mainframes, though showing respectable, steady growth, are bringing up the rear.


U.S. DATA•PROCESSING•EQUIPMENT SALES

Though the major European markets—those of the UK, West Germany, Italy, and France—are each expanding at somewhere around the European average, more spectacular growth is to be found in two less obvious countries. "Norway is getting an enormous push from North Sea oil, and I would say that this market is currently expanding by as much as 20%," Volmer says. "Spain is preparing itself for membership in the European Community and is investing heavily in computer systems."

Among mainframe companies in the U.S., Control Data Corp. has been rocked hard by the rough road slowing the industry. In the first quarter this year, CDC posted a loss of $9.2 million. Since the first of the year, it has cut back employment from 54,000 to 52,000 worldwide, and there will be more layoffs coming. CDC also implemented a 10% salary cut starting April 1 for executives above the rank of vice president.

In contrast to CDC, Burroughs Corp. had a good year in 1984, with record revenues and orders as well as increased profits. Its first-quarter results continued that trend, says Kenneth Calmenson, vice president of worldwide product marketing. He says earlier internal projections for 1985 to date are about on the mark.

Sperry Corp. reports good news in its mainframe business, particularly shipments of the top-end model 1100/90, which is stronger than predicted, says Jan Brundin, vice president of product strategy.

But except for Compaq Computer Corp., growth in the personal computer market seems to be screeching to a halt. Compaq continues to ride high on the wave of success it has been enjoying since it launched its first transportable model compatible with the IBM Personal Computer. Unlike much of the personal computer industry, Compaq reported a 42% rise in its first-quarter earnings and a 54% jump in revenues.

However, the rest of the personal computer manufacturers face a market that is drying up and cutting deeply into profits. "We don't do much forecasting, but we are doing worse than I thought we'd do," says George Morrow, president of Morrow Designs Inc., a San Leandro, Calif., maker of 8-bit personal computers.

For personal computers in general, "I think it's going to get worse," Morrow continues. "Up until maybe the first part of this year, the big leaders were little companies that didn't have resources to bleed, bleed, bleed. People in the game now are people like AT&T, Sperry, Apple, and IBM. With the exception of Apple, they're all dinosaurs—cut them in the middle, and it takes two weeks before either end knows something's bleeding. They can hold out a lot longer."

According to Morrow, the 8-bit market is virtually extinct except for those value-added resellers that use it. The retail channels find these machines impossible to sell, despite the fact that they offer more computing power for the dollar. Morrow is now trying to design a 16-bit machine that is cost effective—in the $1,500 range—that he hopes to announce next year.

The picture is not much better for personal computer makers in Japan, according to Yuichi Murano, data-processing analyst with Dataquest Japan Ltd. "Personal computer sales are still flat and 1985 will be a bad year," Murano says.

As for Europe, Ing. C. Olivetti & C., Italy's leading producer of data-processing and office-automation systems, is optimistic about personal computers. "We're looking for growth of more than 60% in the Western European personal computer market," says Enrico Amiotti, manager of comparative economic studies in the company's Corporate Economic Research Department. "But we're also going to see a personal computer market that is much more segmented than we are used to. The day of the plain-vanilla [personal computer] is over, and we're going to start seeing more different flavors."

Part of the general weakness in computer systems markets is a result of a general lack of confidence in the economy, says Tom Ellis, vice president of Texas Instruments Inc.'s Data Systems Group in Austin, Texas. As for the personal computer segment, Ellis believes "there is an indigestion" problem in the Fortune 1,000 companies because so many machines were bought in a short period of time. Now, he says, companies are finding the next wave of users need more training and support. Companies attempting to link individual users' computers with mainframes are finding the cost is about four to five times what they had planned.

Other potential buyers are attempting to better understand the multiuser alternatives, including minicomputer-class systems, the new machines based on Intel's 286 microprocessor and the entire local-area-networking issue. That all adds up to delays in purchases.

A peripheral outlook. One barometer of future business activity in the computer industry as a whole is the sales level of floppy disks and peripheral components, notes Dataquest's Murano. These sales usually portend patterns six months ahead of the industry in general. "We feel the floppy-disk market bottomed out late last year," he says. "Now, it is picking up just a bit."

He also sees some increase in components and other peripherals sales. Peripherals-sales predictions from Toshiba Corp. bear him out. Toshiba predicts a 50% rise in its peripherals sales in 1985.

Murano points out that that 80% of the floppy disks and peripherals produced in Japan go to the U.S. Therefore, his estimate is based to a large degree on an assessment (accurate or not) of U.S. market opportunities.

DATA-PROCESSING EQUIPMENT GETS HIT BY THE SLUMP

	1984 Sales	1985 Forecast six months ago	1985 Current forecast
	$ Billions		
Single-user systems	15.9	26.5	22.9
Work-group computers (under $25,000)	2.2	3.2	3.7
Small department systems ($25,000 to $75,000)	3.3	3.1	3.6
Large department systems ($75,000 to $250,000)	2.9	3.7	3.4
Business-unit and corporate-resource systems (over $250,000)	12.0	13.0	13.3
Totals	36.3	49.5	46.9

SOURCE: DATAQUEST INC.

At Control Data's Peripheral Products Co., president Lawrence Perlman says, "We thought [1985] business was going to be stronger than it is. Unless there's some kind of dramatic change, it looks now like the peripherals industry as a whole will have lower revenues in 1985 than in 1984."

Perlman says there are both short-term and fundamental problems in the peripherals market right now. The short-term problem is the softness in the original equipment manufacturer computer and office-automation markets as customers defer purchases while waiting for new products to come out.

The fundamental problem is the fact that although revenues are not rising, the number of megabytes shipped is going up dramatically. For example, CDC has a 9-in. 515-megabyte model that generally replaces a 14-in. 300-megabyte unit. The 9-in. product sells for about $5,000 and, with about twice the storage of the older $9,000 product, represents a 70% reduction in dollars per megabyte, he explains.

The same thing is true in basic 5¼-in. products. Says Perlman: "We've got to sell four times as many units just to maintain flat revenues, and yet we've got to get the cost down so we can make a profit."

Asked about the prospects for a market upturn, he says, "If it's going to happen in 1985, it will be late in the year." An upturn will be stimulated by the movement of OEM customers that are now waiting for new products. "The quality of new products coming [is] bound to stimulate increased demand," he says.

One major maker of 5¼-in. disk drives doesn't think its segment is so bad either. In Scotts Valley, Calif., Seagate Technology chairman Al Shugart says, "Nine months ago we predicted that business would be slow. Now it looks pretty bullish. I don't think the [personal computer] business is as bad as people say it is. There are just too many people in it. The business as a whole is growing."

Minicomputers hurt. At Digital Equipment Corp., "We've seen a softer market in some [areas] we didn't expect," says Ed Kramer, group vice president for technical markets. Still, Kramer reports that DEC's business outside the U.S. is well ahead of plan, but at home there are problems.

"We continue to sell heavily to manufacturing companies and not service industries, and many of them are involved in export [where there is] a softening because of the dollar," he points out.

In Japan, Toshiba's most recent estimates of minicomputer sales indicate it will grow only 3% this year.

TELECOMMUNICATIONS

GLAMOROUS BUSINESS FARES NO BETTER

Telecommunications equipment makers may be part of a glamorous growth business, but so far this year, they have fared no better than the rest of the electronics industry. They had rough sledding.

Though industry analysts predict that the current $75 billion worldwide market for telecommunications equipment and services could double within five years, common carriers in the U.S. are still feeling the effects of the Bell system breakup, and suppliers of end-user equipment attribute their woes to the general downturn in the business cycle.

The confusion surrounding deregulation has already taken its toll on suppliers of common-carrier equipment. "A year ago, after the breakup of AT&T, a lot of the western Bell operating companies stopped buying anything," says Gilbert Johnson, chief operating officer of California Microwave Inc., a supplier of common-carrier microwave gear.

"Those operating companies didn't know who was supposed to buy what and who owned what. That impact slowed down the commercial business," Johnson says. "We have started to see glimpses of light," he says, and he expects an upturn in business as the operating companies begin buying again and independent carriers such as MCI and GTE Sprint gain strength in the new competitive environment.

If suppliers to the common carriers need only point to deregulation to find a scapegoat for the hard times, vendors to end-user markets are not so blessed. Working against commercial telecommunications manufacturers this year are soft market conditions, new tax laws, and some marketplace confusion they brought about themselves.

Lower capital spending. Overall capital spending has been less than half the 14% to 15% laid out during 1984, delaying large capital purchases such as private branch exchanges, says Richard L. Herander, senior vice president of finance at Intecom Inc., Allen, Texas, a pioneer PBX maker that was forced to lay off about 200 people in late March.

A spate of new PBX product introductions by Intecom, Northern Telecom, AT&T, and Rolm may actually have caused some confusion in the marketplace, as buyers sort through the offerings. Robert Potter, group vice president of integrated office systems at Northern Telecom, recognizes that competiton among PBX vendors has stiffened: "Everybody has seen this giant prize out there, so you've got a lot of companies trying to get a piece of it, and that's fundamentally healthy."

A June 7 Federal Communications Commission ruling is the latest cause of confusion in the industry. The ruling prevents the regional operating companies from automatically assigning customers who fail to designate a long-distance carrier to AT&T Co.

However, the move could possibly provide new opportunities for both equipment carriers and vendors. For carriers, the FCC decision could induce new subscribers to sign up for long-distance services; manufacturers could benefit because these non-AT&T carriers will need new equipment to handle the increased traffic.

If telecommunications has a promised land, it may be overseas. The mood among telecommunications suppliers in Japan is very upbeat, thanks to recently enacted market-reform laws that changed Nippon Telegraph & Telephone Public Corp. from a monopoly to a private company. An overall Japanese market valued at $4 billion in 1983 will be worth $5.8 billion this year as a result of deregulation, according to a market forecast by the U.S. Embassy in Tokyo.

The medium-term prospects for European makers of communication equipment are bright, with digital private and public branch exchanges, 64-kb telecopiers, local-area networks, and a host of other equipment keeping the market humming. Hans Otto Matt, an official in the Communications Group of Munich's Siemens AG, estimates a 10% annual growth rate for Europe during the next few years.

Exceeded estimates. In West Germany, for example, "the communications-equipment market so far this year has exceeded earlier estimates by far," says Matt. He sees domestic sales increasing by between 10% and 15% in 1985, with the voice-based communications sector (including telephones, terminals, and private and public branch exchanges) growing at around 10% and the data-communications sector at better than 20%.

What is stimulating the market, Matt declares, is the change from analog to digital technologies and the growth of the office-equipment sector. He thinks the 10% to 15% growth for West Germany's telecom market can be sustained for the next two to three years.

TEST & MEASUREMENT

U.S. PRODUCERS WOULD SETTLE FOR FLAT GROWTH

Before the year began, the outlook for 1985 seemed rosy for the U.S. test-equipment market. Prime Data predicted 18% growth following 1984's 20% gain. The San Jose, Calif., market researcher recently slashed that forecast to 5%. Right now, most U.S. experts would settle for flat growth.

Though others weren't quite so optimistic to start with, they didn't expect the drop-off to be so steep. At Hewlett-Packard Co., economist Richard O'Brien says, "Our plan was for a year that wouldn't be good, but no one was planning for a year that was this poor. We thought 1985 was going to be a weaker year than 1984 because of our forecasts of general economic conditions." He adds that the industry is "probably having its roughest period since 1970."

O'Brien sees the U.S. economy picking up in the second half. "Lower interest rates will have a positive impact on our business. And the gradual weakening of the dollar is also going to have a positive impact."

This year's slowdown could be worse for the test industry than the recessions of 1974-75 and 1982. O'Brien, who notes that HP's business forecast for the year is off "substantially," believes the Palo Alto company's business will bottom out in the third quarter. This will be the firm's worst performing period because the trends are still heading down. "I think there is some light at the end of the tunnel, but for right now, the numbers are still headed south."

The picture is different in Japan. Its test-equipment market had as spectacular a performance in 1984 as its chip makers', and they continue to show that strong growth in this year's first half. Memory-tester market leader Takeda Riken Co., whose sales last year were twice its 1983 total, still sees close to 50% growth for fiscal 1986, which ends next March, as does Ando Electric Co., which follows Takeda Riken in both memory and logic testing markets.

However, analysts see a different future for the Japanese. Because of the usual lag behind semiconductor trends, they predict, makers of test- and measurement gear probably won't suffer as much this year as chip makers. But by late 1985 and early 1986, the lag will catch up with them and there will be downturns in sales and earnings.

As for Europe, Philips is the yardstick. Bill Whitward, manager of the business unit for test systems in Philips' industrial and electroacoustic systems division in Eindhoven, the Netherlands, sums up business in one word: "Excellent." He cites the 30% increase in business his division has scored during the first four months of this year over the same period last year.

That spurt puts Philips, Europe's biggest testing-equipment producer, ahead of its competitors. "We are reasonably sure that we are growing faster than the market itself," Whitward says.

No complaints. But other companies aren't complaining. West German firms indicate that their business has been fairly buoyant so far this year, exceeding the expectations of a year ago. A major factor is the booming communications market in West Germany. The momentum should keep the test-gear market there growing at a high rate for the rest of 1985 and much of next year. Whitward sees Philips's business expanding 20% this year compared with 1984.

Turning to individual countries, Whitward sees the French market for Philips as performing "very well." The same is the case for the UK, West Germany, and the Scandinavian countries.

Contributing to this special report were: semiconductors, J. Robert Lineback; components, Michael B. Rand; data processing, Tom Manuel; communications, Robert R. Rosenberg; test and measurement, Jerry Lyman; with bureau reports. Editor in New York was Robert J. Kozma

TV's TECHNOLOGICAL REVOLUTION MAY BE A PIPE DREAM

by Robert T. Gallagher

BROADCASTERS SAY ECONOMIC REALITIES HOLD BACK UNLIMITED SERVICES FROM CABLE AND DBS

Montreux, Switzerland

The technology is ready and willing, but the broadcasters just aren't able. That, in a nutshell, is why the next TV revolution may be stillborn, as it became apparent at the 14th Montreux International TV Symposium.

The contrast between the dream and the reality was striking. In a small octagonal room adjacent to the gaping conference hall where TV industry executives and broadcasters were discussing the future of their medium, equipment manufacturers had put together their own contribution: a futuristic display of TV sets and terminals, all under the title "the living room of tomorrow."

Given the market-ready look of the high-definition TV receivers with their associated terminals and gadgetry for interactive cable services, an onlooker could have been forgiven for thinking that a TV revolution was only a couple of years, if not months, away.

Just next door, symposium participants were delivering a very different message. The world's broadcasters were questioning not only the imminence of an explosion in TV services, but even whether it would be desirable. This dichotomy is symptomatic of a growing schism between the sophistication of TV broadcasting technology and the broadcasters' means of putting that technology into service.

Most industry observers have long expected direct-broadcast satellite and cable distribution to vie for the lion's share of the next generation (after standard, terrestrial broadcast) TV market. DBS would offer an exponential increase in the number of available channels while distributing them over a broad area with sufficient bandwidth to enhance TV quality. Cable distribution would open the door to interactive and other value-added pay services.

However, the future of both is now clouded. The dream of an endless choice of programs and services from a virtually unlimited number of sources is in serious jeopardy.

"The technology is there, but the problems are economic," laments George Waters, who recently retired from his post as director general of Radio Telefis Eireann, the Irish national broadcasting authority, to become chief executive officer of Olympus Television. Olympus was set up by member countries of the European Broadcasting Union—Ireland, Italy, the Netherlands, and West Germany—to use the technological opportunities afforded by DBS to provide a pan-European service.

"There are only three European countries—France, Germany, and the UK—that are big enough and wealthy enough to support their own DBS pro-

Future hope. Direct-broadcast-satellite dishes at the Montreux symposium symbolize the TV technology that broadcasters believe is economically unfeasible now.

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grams," he asserts. "And cable has been far slower to develop than people originally thought because it is just far too expensive to install cable networks.

"Everywhere I know of—the UK, France, the U.S.—cable has started with great fanfare and then slowed down considerably as it ran into various kinds of difficulty," Waters points out. "Belgium and Holland might claim that they are exceptions with about 80% penetration, but in most cases it is not interactive cable and is a limited service in that it is not broadband, either."

Urging a cure. Waters believes sharing will cure DBS's ills, with countries, particularly the smaller ones, getting together to apportion costs. He points out that it is already happening as some European countries gear up to offer DBS services. Waters is far more pessimistic about the future of cable, however. "I think it will be at least 20 to 30 years before cable distribution reaches even half the population. The public just isn't ready for it yet."

Some executives explain that what is holding back cable distribution is the fact that it is often difficult to justify the charge for pay TV. "When you look at the price of a cable subscription, it comes to something like $20 or $25 per month—$10 for the basic service and the rest for supplementary programs," reasons B. J. Lechner, staff vice president for advanced video systems research at RCA Corp.'s David Sarnoff Research Center in Princeton, N.J.

"The problem is that in most areas the subscriber can have the basic service for free with normal TV reception," he explains. "Then, if he wants supplementary service, he buys a VCR and he can rent exactly the tapes he wants for a dollar or two each and watch them when he wants."

A problem will be to find programming for the new channels

Pieter den Toonder, managing director of Oak Communications Inc. in Dordrecht, the Netherlands, and moderator of a symposium session on the evolution of home terminals, agrees that the video cassette recorder is a serious threat to pay TV, but says it is no more threatening than the industry's own lack of standardization.

"Cable TV decoders are basically TVs without screens, and they currently cost about $200; that means that an operator with a large number of decoders in stock is financing a sizable investment," den Toonder points out. "It's very important to get that cost down by at least 50%, but it's hard to see how it can be done when every manufacturer has a slightly different approach to making them. The only solution is standardization. But the real question is whether or not we can do it soon enough."

Den Toonder is betting that cable services eventually will lose out to DBS to provide the next generation of TV services. He also expects that the integrated services digital networks that most telecommunications authorities are currently planning will meet that demand.

"The real key to interactive services is how quickly the last kilometer of copper wire [from the telephone exchange to the subscriber] gets replaced by optical fiber," says RCA's Lechner. "But even after that, there are potential problems, like terminals. When you look at Biarritz [France's cabled-city experiment], you see that the French authorities simply added a cathode-ray-tube display and keyboard to a standard telephone. It won't be as simple to have something like that happen in the U.S. now that AT&T has divested its operating companies."

Cable's only hope may be standardization and cutting costs

When and if the problems of cost and standardization are solved, that will mean only that the time has come to worry about content. Both Lechner and den Toonder are convinced that no matter what the transmission medium, determining the kind of TV services the public wants requires some solid marketing research.

Ask the viewer. That idea wins the eager endorsement of William Baker, Television Group president at Westinghouse Broadcasting Co. "We, the consumers, are getting more and more skeptical after having bought a lot of useless goods in the past," asserts Baker. "For once we, the broadcasters, are going to have to do the market research necessary to find out what the viewers really want."

Other participants expressed even more basic worries. They wondered from where the resources—both economic and human—would come to fill all the new channels coming on line.

"Who is going to make the programs? Where is the talent?" asks Alastair Milne, director general of the British Broadcasting Corp. "Will we have no choice but to use the U.S. as our source of programs, or will we just fill the channels with potential horrors like endless movies of the same kind? The question we must ask ourselves is how we can originate more material of quality." ☐

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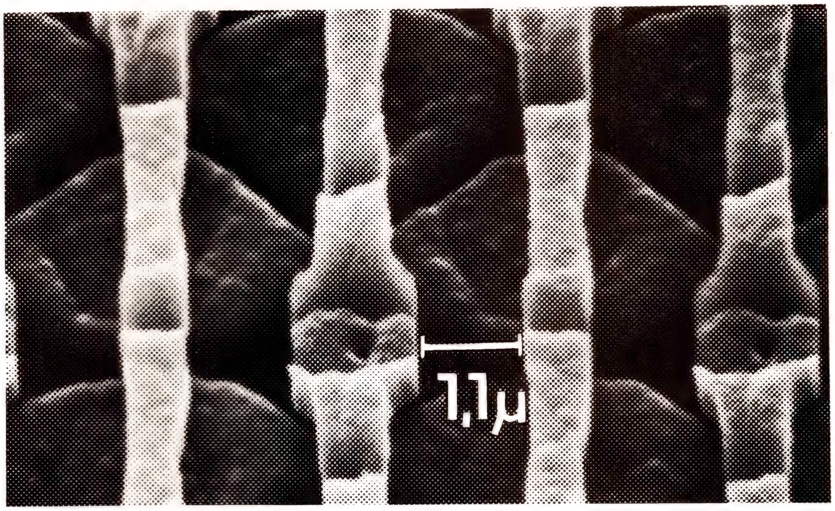

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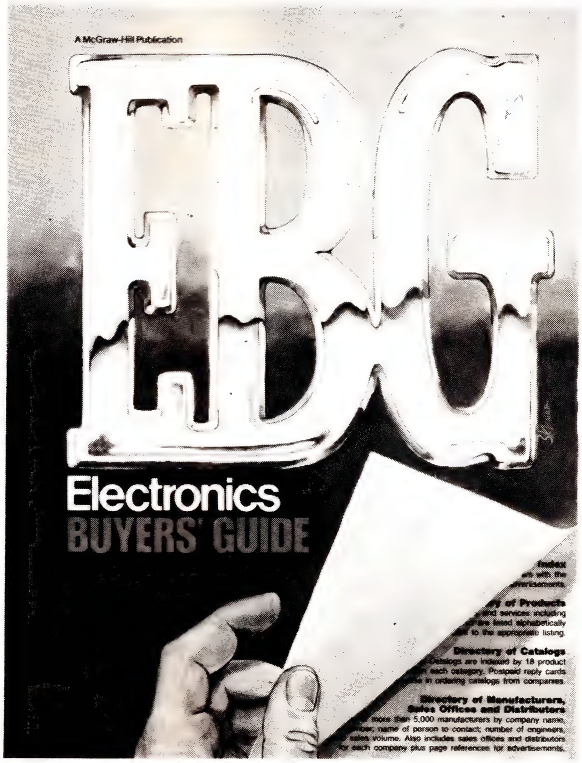
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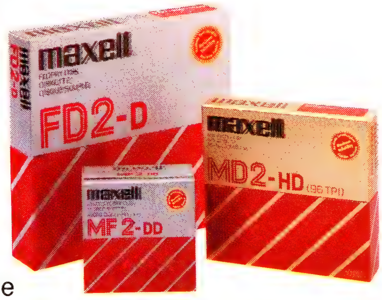

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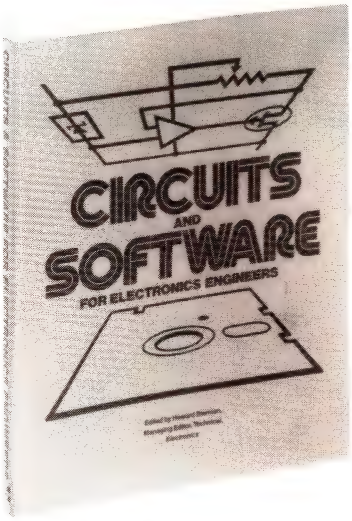

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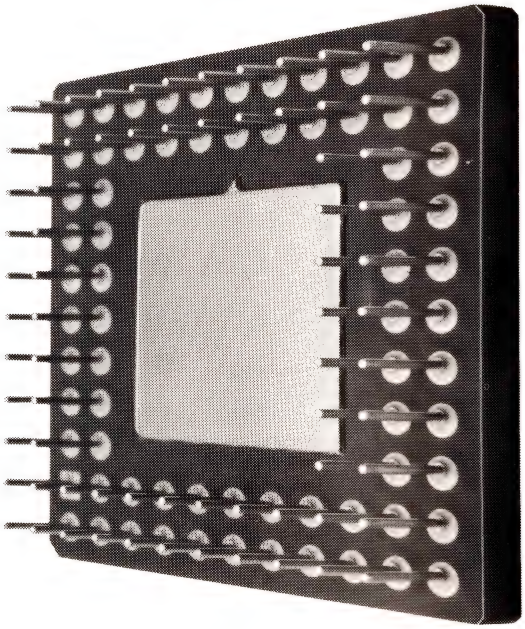

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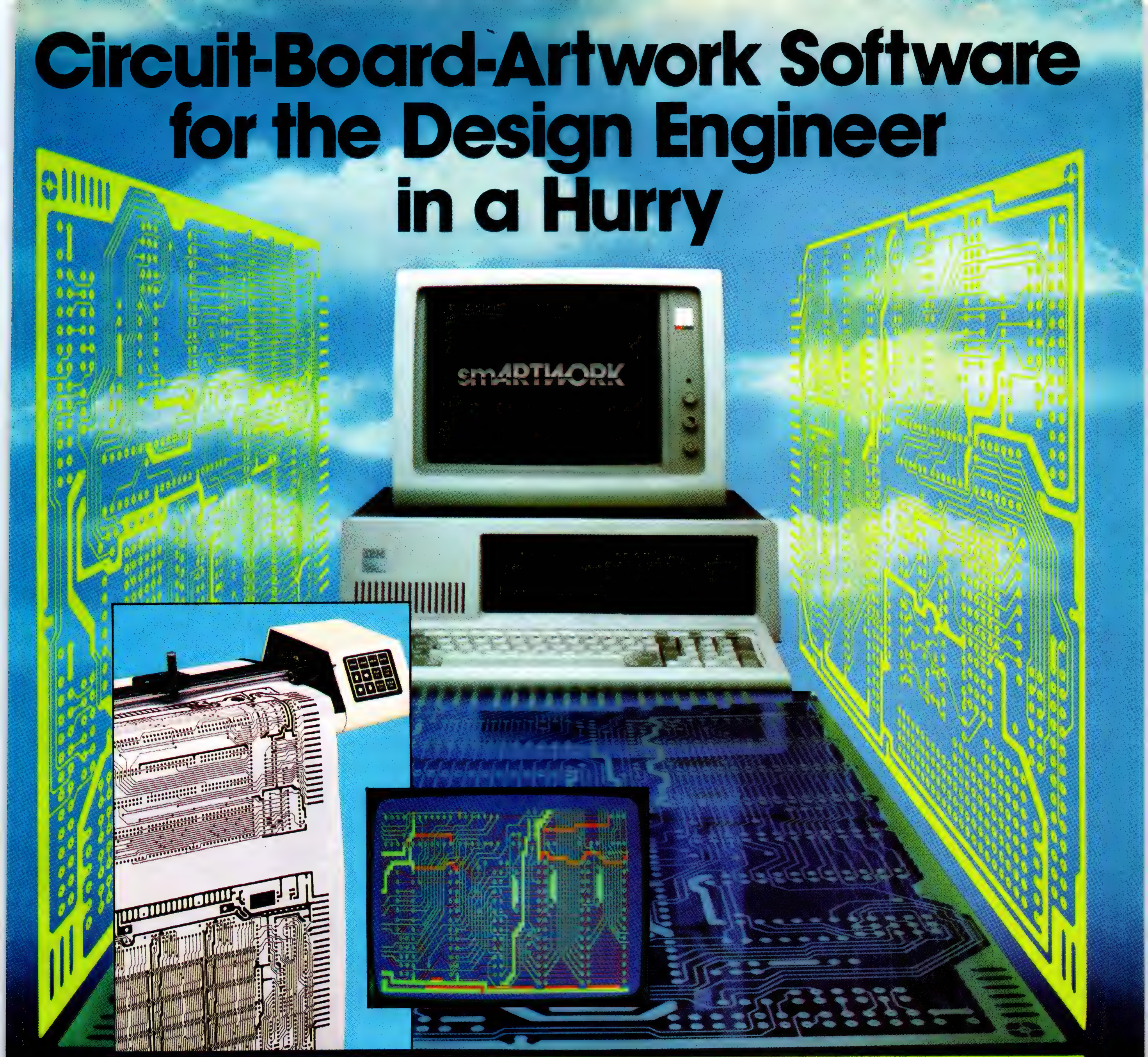

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PLAYERS

GOLD HILL COMPUTER GIVES IBM PCs THE SMARTS

Offering artificial-intelligence software for PC users, the company battles ignorance and marketing hype in quest for easier solutions

Cambridge, Mass.

The people at Gold Hill Computers Inc. believe the problem with artificial intelligence is ignorance. People don't understand what AI can accomplish, or they don't know enough about its languages to use it, or both. So many potential users sit at their personal computers struggling with spreadsheets while the benefits of artificial intelligence go untapped.

Gold Hill's solution to this problem is a Common Lisp subset and tutorial that runs on IBM Corp.'s Personal Computers. It is a solution that has moved the young company into the leading position of an emerging business.

Eugene Wang, Gold Hill's vice president of marketing, estimates there are 2,500 AI experts in the country versus the "tens of thousands necessary to commercialize the technology." Many more users would like to explore AI and are looking for a low-cost entry point.

Offering suitable software for these users could prove to be a $1 billion business in the near future, according to market researchers. Gold Hill has a more enthusiastic view: Wang quotes estimates that predict the AI business in general will total $11 billion by 1990. But for now, the training of programmers and the expense of dedicated hardware hamper the business's growth.

Gold Hill executives believe personal computers are the key to breaking open the market. "When people come [to us] to ask about AI, the first thing they ask is, 'How can I make it work on my PC?'" says Thomas Martin, a senior consultant at Arthur D. Little Inc., a market research firm in Cambridge. "We used to tell people, 'Not yet,' but what came out in 1984 [from Gold Hill and others] is at least a glimmer."

Gold Hill's homegrown subset of Common Lisp, called Golden Common Lisp, is marketed as a training and basic-development tool. Company executives believe that in the long run, as a result of having trained customers using Golden Common Lisp, Gold Hill will have established a major position on the desktop as one end of a conduit for future AI solutions.

This strategy runs contrary to the notion that customers will rapidly abandon personal computers for more powerful machines as their interest in AI grows. But Gerald Barber, Gold Hill's president, says a market will remain for AI on personal computers. "Probably a [personal computer] is where you need AI the most," he says. "Where the user is not a computer scientist or programmer, then you need a system to fulfill the user's needs."

Student entrepreneurs. Gold Hill was incorporated in 1982 by Barber, Stanley Curtis (who recently shifted from president to vice president), and John Teeter, vice president of engineering. The three met as students at the University of Idaho and named their company for a mountain in that state. Their first effort, a coprocessor for Zilog Inc.'s Z80, did not get far, but later, a Logo software product for the IBM PC was successful.

Soon they noted the increasing power of the PC and seized on the idea of adapting AI to the IBM machine. In September 1983, Barber, who had been working in France, returned and converted a sophisticated Lisp program he had been developing into a PC Lisp. The subset now incorporates about 70% of Common Lisp's primitives.

At about the same time, the trio teamed with Patrick Winston, director of the AI lab at the Massachusetts Institute of Technology, who was rewriting his well-known book *Lisp*.

All happy. "We wondered how we could [offer] a product with appeal, [while] Winston wanted to know how to give people hands-on experience with Lisp," says Barber. Putting Lisp on a personal computer made both sides happy, and Winston joined the company as a director. His revised textbook became part of the Golden Common package.

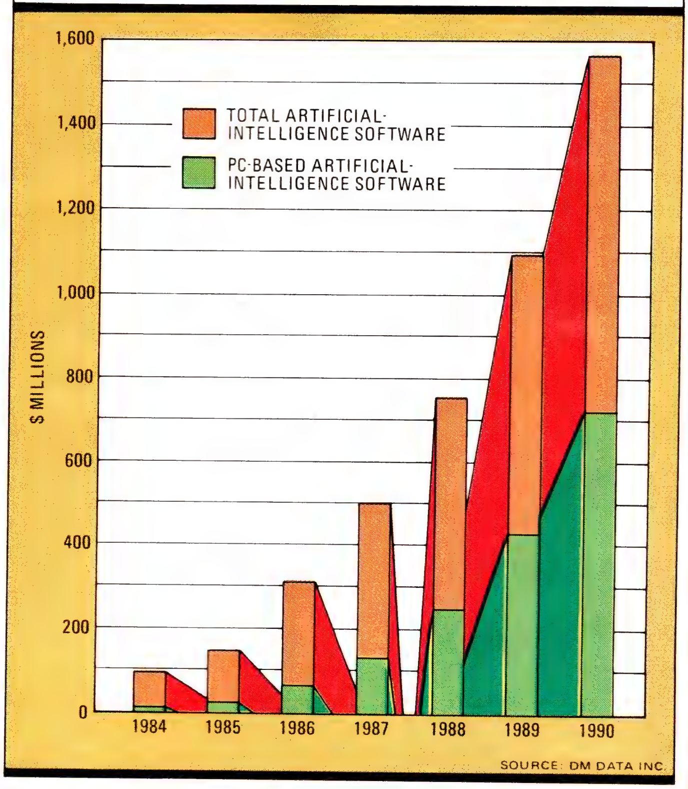
In the summer of 1984, the company raised a round of venture capital from a group of investors including Memorial Drive Trust, Fairfield Venture Management, and Churchill International. Gold Hill first demonstrated Golden Common Lisp at the American Association for Artificial Intelligence show in Austin, Texas that year, and Curtis says the show got the company off and running.

People at Gold Hill are quick to point out that the use of AI software on personal computers is still an embryonic business with no major success stories yet. They also add quickly, however, that Gold Hill is the revenue leader of the young business, claiming sales of several thousand units.

As with many fledgling businesses, estimates of the current and future size of the AI-software market—and the personal computer portion of it—vary greatly. According to Susan Messenheimer, publisher of the "Artificial Intelligence Markets" newsletter based in Framingham, Mass., AI-language software sales in 1984 totaled $8 million, with just a bit over $1.5 million spent on personal computers. She estimates that Gold Hill captured about 39% of that business and shipped about 1,200 units. About 20 companies are marketing AI-language products for personal computers. Messenheimer further projects that the overall AI-language business will grow by 1990 to $334 million.

DM Data Inc., a market research company in Scottsdale, Ariz., takes a more optimistic view of the AI-software industry's growth potential. The firm estimates

IBM PC-BASED AI SOFTWARE SHOWS A LARGE POTENTIAL



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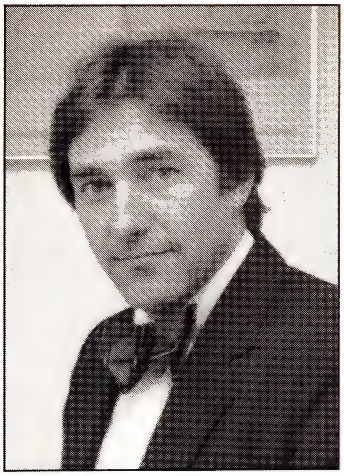
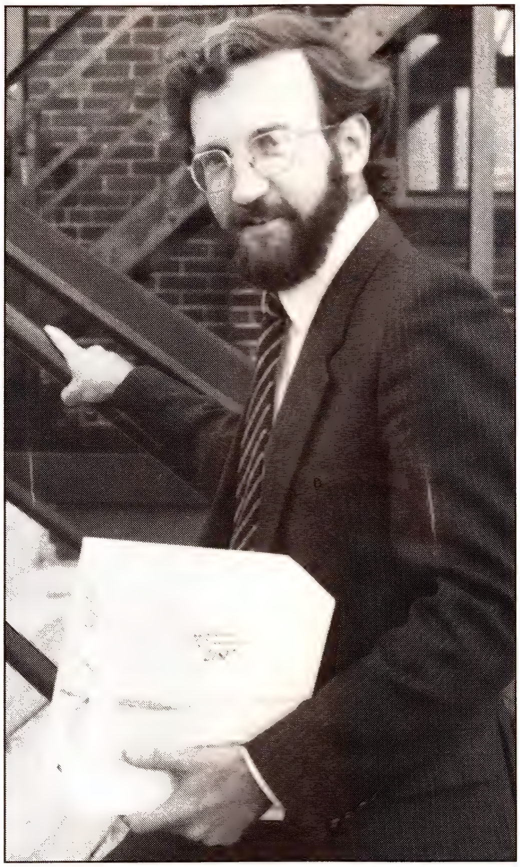




Struggle. Cutting through the hyperbole associated with the artificial-intelligence business in general is a challenge, say Gold Hill Computer president Gerald Barber (right) and vice president Stanley Curtis.

that the AI-software market last year totaled $90 million, with AI software for use on all types of personal computers at $10 million. By 1990, DM Data expects that the total AI-software market will exceed $1.5 billion, with personal computer AI software totaling $726 million.

Still, notes Messenheimer, "The ability to build a company on programming languages is questionable." Companies such as Gold Hill, must offer development tools or Lisp-based operating environments to sustain long-term growth.

The company has already begun to move in that direction. Its next product will be a compiler for the IBM PC, which will enhance the PC's utility as a development tool. By providing both training and basic tools, Barber says, "We're getting the customer early, building the customer base."

The Gold Hill executive expects that some of those customers will quickly run into the limits of their machines. These users, he says, "will follow the curve into the high end. Others will have a mix," says Barber. For the high-end customers, Gold Hill says it will develop quality tools.

New focus. What will also be important, says Barber, is networking and communications capability. AI, he believes, demands networks of a special nature because the technology will depend on very intimate communications. "These systems don't exist in a vacuum," he points out. In the near future, Barber says, "The focus will be on communicating. The network is one place where there will be a lot of activity."

Meanwhile, other companies are exploiting Prolog for the IBM PC, but not Gold Hill. "Our view is that Prolog is one branch further down the AI tree [of knowledge processing]," says Barber.

Gold Hill says it has found that the largest number of its customers in Fortune 1,000 companies are interested in building expert systems. A smaller number of its customers are in universities and still fewer do defense work.

Countering the hype. A major concern in the general marketplace, says Wang, is that pervasive advertising claims and hoopla associated with artificial intelligence will sour the market. This could overshadow what Gold Hill describes as the considerable existing potential of AI on the PC—a potential that will grow quickly.

To help realize that potential, Golden Common Lisp is sold through a network of 100 dealers. This past spring distribution began in Europe, Japan, and Scandinavia. The firm is also working with NEC Corp. of Japan to adapt Golden Common Lisp to that company's line of personal computers.

Barber says one of the biggest challenges facing an AI software vendor is to make itself understood because customers' eyes can glaze over quickly when bombarded with the abstract language of AI.

"There's no joke about that," he says. "We have to spend a lot of time getting rid of the jargon and getting the idea across." And then the challenge is to make it easy for customers to use AI to solve real problems. *–Craig D. Rose*

BOTTOM LINES

Computer trade balance rises

The U.S. enjoyed an increased positive trade balance in computers and business equipment in the first quarter of 1985, says the Computer and Business Equipment Manufacturers Association, but the picture for all of 1985 is another story. According to the Cbema, the favorable trade balance in computers and business equipment increased 51.7%, to $1.392 billion, from $917 million in the first quarter last year. U.S. industry exports rose 24.7%, to $4.441 billion, from 1984's $3.562 billion. Imports were up 15.3% in the 1985 first quarter, to $3.049 billion from $2.645 billion last year.

However, the Cbema estimates that the trade balance for all of 1985 will drop to $4 billion or less from the 1984 trade surplus of $4.7 billion. "These projections could be changed as a result of new trade regulations, technological innovations, and the strength of the dollar," the trade group cautioned.

Computer Products buys Tecnetics

Computer Products Inc. of Pompano Beach, Fla., has agreed in principle to acquire Tecnetics Inc., a privately owned Boulder, Colo., maker of power supplies. Terms of the acquisition were not disclosed. Computer Products said Tecnetics, which had 1984 sales of $9 million, will operate under its current name as an independent subsidiary in its Power Conversion Group.

Forethought in new funding

Forethought Inc., a Mountain View, Calif., software company, has completed a third round of venture financing totaling $1 million. The company, which offers Macware software for Apple Computer Inc.'s Macintosh computer, said the new funds will be used to develop and market its products.

General Automation sells unit

General Automation Inc., Anaheim, Calif., has sold its Technology Circuit Division Inc. subsidiary to Helix Circuits (USA) Inc., a wholly owned unit of Helix Circuits Inc. Terms were not disclosed. Technology Circuit, which has a trade designation of National Technology, makes multilayer circuit boards. It had sales in 1984 of over $20 million. "National Technology, together with Circal Inc., Helix's other subsidiary in southern California, will allow us to more effectively penetrate one of the largest markets for printed-circuit boards in North America," said Helix executive vice president William Weiler. General Automation said it will use the proceeds of the sale to reduce its long-term debt and to develop and market its Zebra family of supermicrocomputers.

PLAYERS

WHY HIS NEW PROJECT EXCITES HARRY HEARD

Santa Clara, Calif.

Though he is a 35-year veteran of the electronics field, Harry G. Heard is anything but blasé about his latest project: "This is so exciting, so important, that anything else I've been thinking about over the past few years has to take second place."

He's describing the John von Neumann Center for Scientific Computing (JVNC), in Princeton, N.J., one of four new supercomputing research sites funded by the National Science Foundation [*ElectronicsWeek*, March 4, 1985, p.13].

Super computerist. Zero One's Harry G. Heard will direct the JVNC supercomputing project.

Last September, his company, Zero One Systems Inc. (formerly Technology Development of California Inc.), began a five-year project to design and operate the facility for a consortium of 12 universities and institutes stretching from New Jersey to Arizona. Founded 14 years ago, Zero One bills itself as "the leading source for supercomputer systems, operations, and integration."

As Zero One's chief scientist, Heard will direct the JVNC program. His prior computer experience includes work on control systems for particle accelerators and the application of lasers and electromagnetic-code development for Defense Department Class V computers.

Stocking up. The center, which Zero One officially announced last week, is scheduled to begin operating Nov. 1. It will feature a Control Data Corp. Cyber 205 connected to four Digital Equipment Corp. VAX 8600s serving as front-end processors. When the first machine reaches the computing saturation point, which is expected within a year, Heard plans to add another Cyber 205 as a "workbench" for short jobs. In 1987 he will add a four-processor supercomputer, ETA Systems Inc.'s ETA 10.

Heard would also like to see an eight-processor supercomputer capable of 10 gigaflops (billion floating-point operations per second) added by 1990.

"The hardware is pretty straightforward," Heard says, but he points out, "The crux of the whole matter is how you get access to the supercomputer." Access will be maintained primarily over T1 lines (with 1,544-kb bandwidth) in a star-shaped network with nodes at each university. Though he acknowledges "we're not creating anything new technically," he says the difference is that "heretofore, if you wanted to use a supercomputer you traveled to the site."

The communications system also includes satellite links of 56- and 64-kb channels, growing to a full 1,544 kb as needed, plus what Heard calls "the widest-band-width, full-duplex dial-up systems we can purchase"—2,400 baud at first, and 9,600 baud when available. Starting with 128 incoming lines, the system will grow to 2,000 lines within a year.

Remote communications will use the Arpanet TCP/IP transport [*ElectronicsWeek*, May 13, 1985, p.34] and internet protocols. TCP/IP is embedded in the University of California at Berkeley 4.2 Unix operating system that many universities already use.

Heard is also working on an NSF study aimed at finding a low-cost mini-supercomputer. He proposes that "modest-performance" 64-bit vector-processing systems with compatible instruction sets could effectively take some of the load off supercomputers and serve as introductory tools for young scientists—and at "1% of the $20 million cost [of a supercomputer]."

Heard gives a simple reason for pushing the limits of supercomputer systems: "I think it's been stated, but we'll never have enough computer power. Very bright people will always use 100 hours on any machine." *–Eve Bennett*

DRI'S HIRAI SAYS COMPUTERS MUST BE MADE EASIER TO USE

Tokyo

Toshimichi Hirai feels strongly that personal computers must be easier to use. Sales growth is sluggish, he maintains, because fewer people are willing to learn how to operate them.

So Hirai, then head of product planning for office automation equipment at Toshiba Corp. in Tokyo, decided to do something about it. He switched jobs to tackle the challenge of developing simpler user interfaces, taking over as president at Digital Research (Japan) Inc., a subsidiary of Digital Research Inc., of Pacific Grove, Calif.

Developing simpler interfaces would have been difficult at Toshiba, he says, "because Toshiba must concentrate on differentiating its machines from those of other manufacturers." At DRI, he will offer software to make applications run similarly on different computers.

Also on his agenda is unifying office-automation machines, including personal computers, word processors, facsimile terminals, digital plain-paper copiers, and printers. "Graphics capability, including icons, is perhaps the most popular approach to simplified interfaces," says Hirai. "It is equally applicable to making the same hardware work variously as a copier, printer, or facsimile." DRI's work on its Graphics Environment Manager is one reason he took the job, he says. GEM uses pull-down menus and windows to ease operation [*ElectronicsWeek*, April 8, 1985, p.36.]

Symbol power. Toshimichi Hirai, president of DRI Japan, thinks use of icons will make it easier to control office machines.

Concurrent efforts. The company's work on Concurrent CP/M and Concurrent DOS 286 also is important because communications require a computer to receive data while it does something else. This ability eliminates the need to terminate and load jobs repeatedly in order to access data in other programs.

Just as Japan now leads the world in memory sales, in the future it will be the leading supplier of all types of chips, including microprocessors, Hirai says. He expects to work with manufacturers to develop operating systems, as his firm is now doing for NEC Corp.'s original V-series central processing units.

Hirai, 47, has a bachelor's degree in physics from Harvard University, and spent more than half of his 23 years at Toshiba in its mainframe division before the company left the mainframe business. In his new role as president of DRI Japan, Hirai hints at a change from his predecessor, who also came from a large firm but didn't really fit in with DRI's corporate culture.

"The first thing I told everybody is that I will not try to bring the way of doing things in a big company to Digital Research," he explains, but is quick to add, "There are both merits and demerits in the way things are done at large firms, and I want to bring the good things." To ease any concern over his ties to large firms, he points out, "Toshiba America in Tustin, Calif., where I worked from 1981 through 1983, is hardly a large firm." *–Charles L. Cohen*

WEADON GUIDES FIRMS THROUGH REGULATORY MAZE

Washington

Imagine a small U.S. company exporting an item such as an electric toaster and having the shipments held up because the product contains a single microprocessor. This real-life example points out the difficulties many small companies face when trying to crack foreign markets, argues attorney Donald Weadon.

To compete with well-heeled international electronics companies, these innovative smaller firms must often look overseas for new markets. But in today's export-control climate, where seven federal agencies make the application process a bureaucratic nightmare, that's where many of the technology-transfer problems begin, Weadon contends.

"Basically what happens is that small firms get sucked into international trade, and they don't understand what's involved," says the export-control specialist and senior partner in the Washington law firm of Weadon, Dibble & Rehm. Since last fall, he has been guiding mostly smaller companies through the maze of federal regulatory machinery [*ElectronicsWeek,* May 20, 1985, p.32]. His firm now represents about 75 large and small firms and is picking two or three new clients each week.

Slow processors. Over Weadon's shoulder and across Pennsylvania Avenue is the Department of Commerce. It is here, he argues, that many of the technology-transfer problems originate. Although the Commerce Department last month announced new regulations governing export licenses that it claims will be more palatable to businesses, Weadon still criticizes the agency.

Claiming the department is slower than its Japanese and European counterparts, Weadon remarks, "Industry should hold a bake sale to raise money to hire more licensing agents." So he proposes some changes—more licensing agents, new methods for streamlined, consistent licensing approval between the Commerce and Defense departments, and industry input.

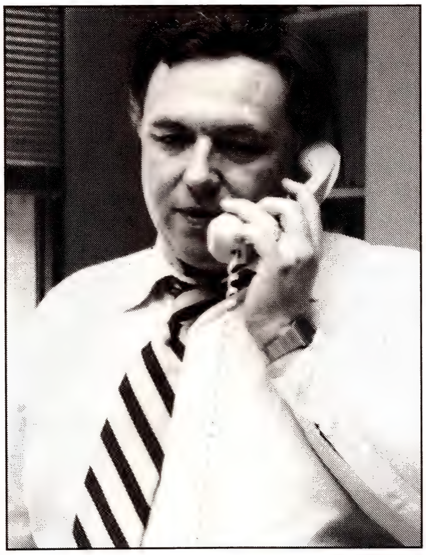
His firm is primarily interested in what Weadon calls the wind-down phase of a technology life cycle. He points out that the best way for small firms to extract the full value of a product's life cycle is through exports to areas such as the Eastern Bloc.

The animated 39-year-old attorney boasts considerable experience in international business and foreign-trade law since arriving in the capital in 1980. He interned at the State Department while studying political philosophy at Cornell University in the late 1960s. Before earning a law degree from the University of California at San Francisco and an MBA from Harvard University in the mid-1970s, Weadon served 3½ years with the Navy in Southeast Asia, where he first came in contact with the idea of military technology transfer.

In the trenches. Although Weadon's firm only recently hung out its shingle, he claims it is the only one working in the trenches because it is the only law firm in Washington working directly with the Commerce Department on a daily basis.

Along with perhaps five other law firms in the nation that concentrate on export controls, his firm is "trying to develop a jurisprudence of export control," he says. Despite his often harsh criticism, however, he says his approach is to cooperate with Commerce in trying to formulate new ways of speeding up the licensing process.

"We see our job as really focusing the issues for them," he concludes. "We ask nothing but fairness." *–George Leopold*



Strategist. "We're trying to [transform] export control from the reactive issue to a strategic opportunity," explains Donald Weadon.

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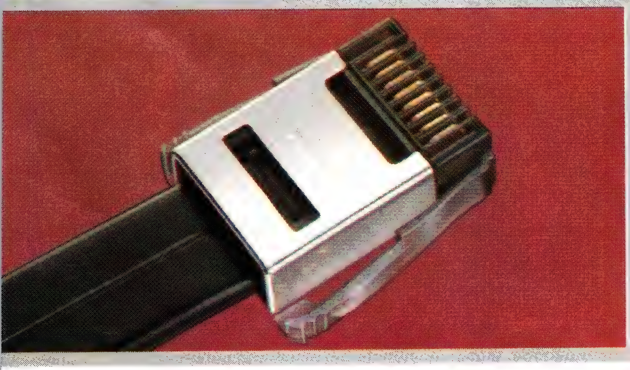

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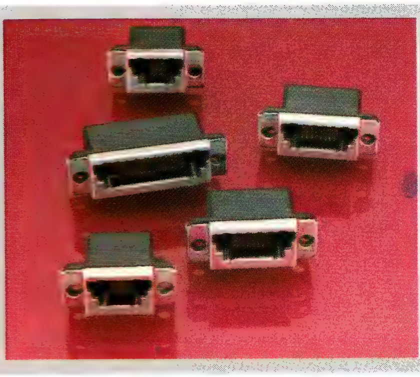

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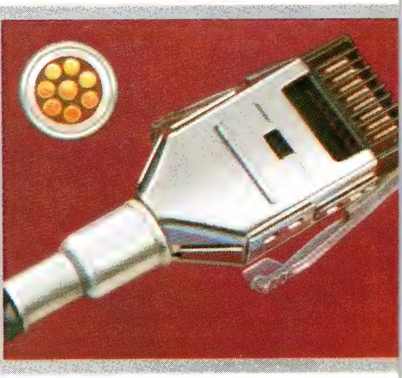

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IC-DESIGN AUTOMATION STRIDES INTO SILICON-COMPILATION ERA

by Jeremy Young

MORE CONVENTIONAL CHIP-DESIGN TOOLS GET BOOST FROM HARDWARE ACCELERATORS, EXPERT-SYSTEM TECHNOLOGY

The merchant integrated-circuit manufacturing industry has outgrown its own imagination. Beyond microprocessors, memories, and a few associated peripheral chips, which can be used in a wide variety of designs, it is increasingly difficult to imagine the function of new very large-scale ICs that will enjoy a large enough market to justify the cost of designing, debugging, and fabricating them.

On the other hand, one of the most effective ways a systems house can add functionality to its products while reducing their cost, size, and power consumption, thus improving the firm's competitive position, is through the design and use of user- and application-specific ICs. If the electronics industry is to make full use of its VLSI fabrication capabilities, it must put design definition back in the hands of the systems engineers developing products for end users.

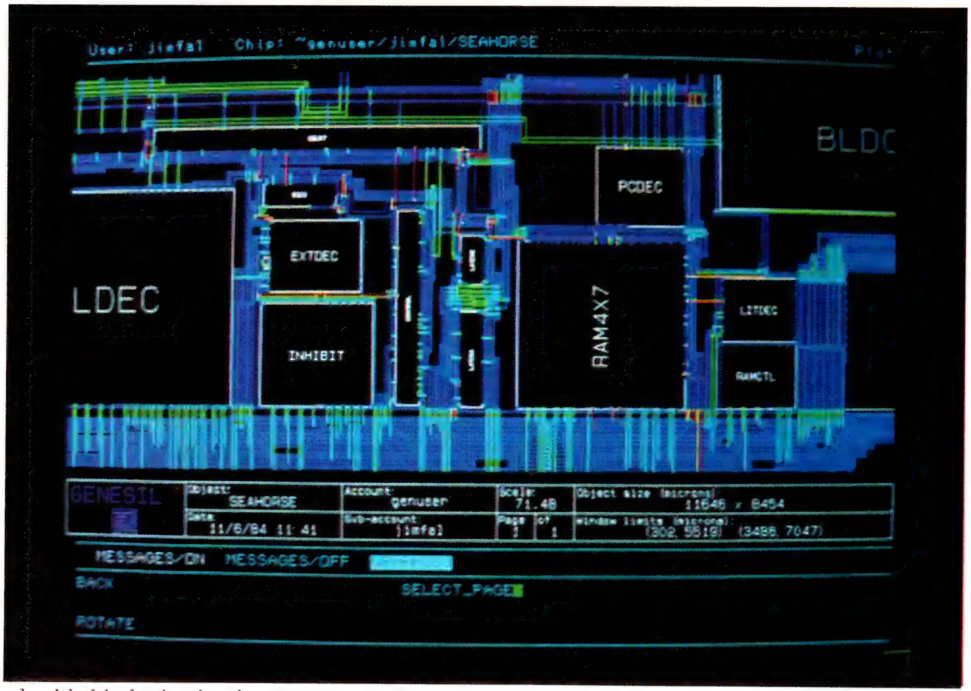
But application-specific ICs by definition must be economical at far smaller production levels than those of their general-purpose cousins. A small or medium-sized systems house cannot afford the kind of development costs that have characterized LSI and VLSI chips in the past. Thus, the growth of the application-specific-chip market must go hand in hand with the development of IC-design tools that drastically reduce the time and effort involved in chip development. But this market may grow by leaps and bounds in the next year or two: the last 10 to 12 months have seen a tremendous increase in the sophistication of commercially available tools, particularly in the area of silicon compilation.

The first wave of application-specific ICs, the semicustom gate array, represents a fairly severe design compromise. The system designer can specify the wiring at the top layer of the chip, but the few-sizes-fit-all philosophy behind the predefined array he is using leads to an inevitable waste of silicon real estate and consequently higher costs; also, many functions he may require, such as analog circuit elements, cannot be integrated with his logic circuitry.

The gate-array market is well on its way to maturity, aided by schematic-capture, logic-simulation, and netlist-extraction tools in the hands of the circuit designer and automatic-routing, geometric-editing, load-extraction, simulation, and other types of tools that by and large remain in the hands of the gate-array supplier. But the industry has been cutting only its first application-specific-IC teeth with this approach.

Standard cells represent the next major step toward efficient use of silicon in application-specific ICs. Standard-cell designs have higher associated manufacturing and tooling costs than gate arrays, because masks must be generated for all layers of the IC. But the circuitry within the predesigned cells can achieve densities near those of full-custom ICs. Furthermore, no more space than is necessary need be left for the interconnections among the cells, thanks to the use of placement and routing tools that operate in both manual and automatic modes, and compaction routines used to tighten up the chip layout.

Beyond standard cells lies the territory of cell-oriented custom design, where individual customized cells can be generated by software once their parameters have been set. For example, a counter, an arithmetic logic unit, or a bus-interface unit might be generated of any required width, in bits, or a multiplexer might be configured with the precise number of inputs needed. This is the area of application where silicon compilation is beginning to come into its own.



User: jimfal Chip: ~genuser/jimfal/SEAHORSE

Object: SEAHORSE
Date: 11/6/84 11:41
Account: genuser
Sub-account: jimfal
Scale: 71.48
Page 1 of 1
Object size (microns): 11646 x 8454
Window limits (microns): (302, 5819) (3486, 7047)

1. Autoroute. A screen lets the user of Silicon Compilers Inc.'s Genesil software see the effects of block placement on the interconnect routing, which is done automatically following the interactive block-placement process. The resulting dimensions of the chip (and the area the user has zoomed in on) are displayed. The blocks are compiled using parameterized Micro-Architectural functions.

As silicon compilers mature, the chips they produce will approach full-custom devices in terms of function, layout, and circuit density. Most compiler makers claim that current products achieve silicon efficiencies 75% to 90% of those of handcrafted custom design. Some industry observers, however, say these claims are highly optimistic.

For the present, tools for full-custom IC design generally operate at the physical-layout level and at the interface between a schematic and the physical layout. They include layout and polygon editors, compaction programs, design-rule checkers, layout-file generators, layout verifiers, load extractors (which derive circuit-loading data from the physical layout to use as input to simulators), and pattern generators for producing a drive tape for mask-generation equipment.

Market for advanced tools set to grow

The overall market for IC design tools is likely to follow a trend paralleling that of the market for application-specific ICs. Dataquest Inc. sees the latter market (exclusive of read-only memories and chips made by captive foundries) growing from $3.3 billion in 1984 to $13.3 billion in 1990.

The market for the geometric-layout tools currently used for full-custom IC design, and thus less closely associated with the application-specific-IC market, will represent a dwindling portion of the overall market. The market for geometric-layout packages in particular will actually drop from $85 million in 1984 to $50 million in 1988, according to the Technology Research Group Inc. of Boston.

The 1984 market for manual IC-layout tools, which is currently dominated by Calma Co., a subsidiary of General Electric Co., stood at $110 million, says the Technology Research Group. The firm projects this market, which consists mainly of turnkey systems, to grow to $340 million by 1988. Advanced layout tools, which include automatic placement and routing software, symbolic-layout packages, and silicon compilers, will at the same time expand from $25 million to $290 million, the firm predicts.

Neither of these groups include the substantial market for circuit-simulation software. TRG sees this market growing from $25 million in 1984 to $250 million in 1988, but many of these systems are used for system- and board-level simulation as well as IC simulation. Dataquest figures put the overall market for computer-aided-design work stations at $157 million in 1984 and rising to over $1 billion in 1989.

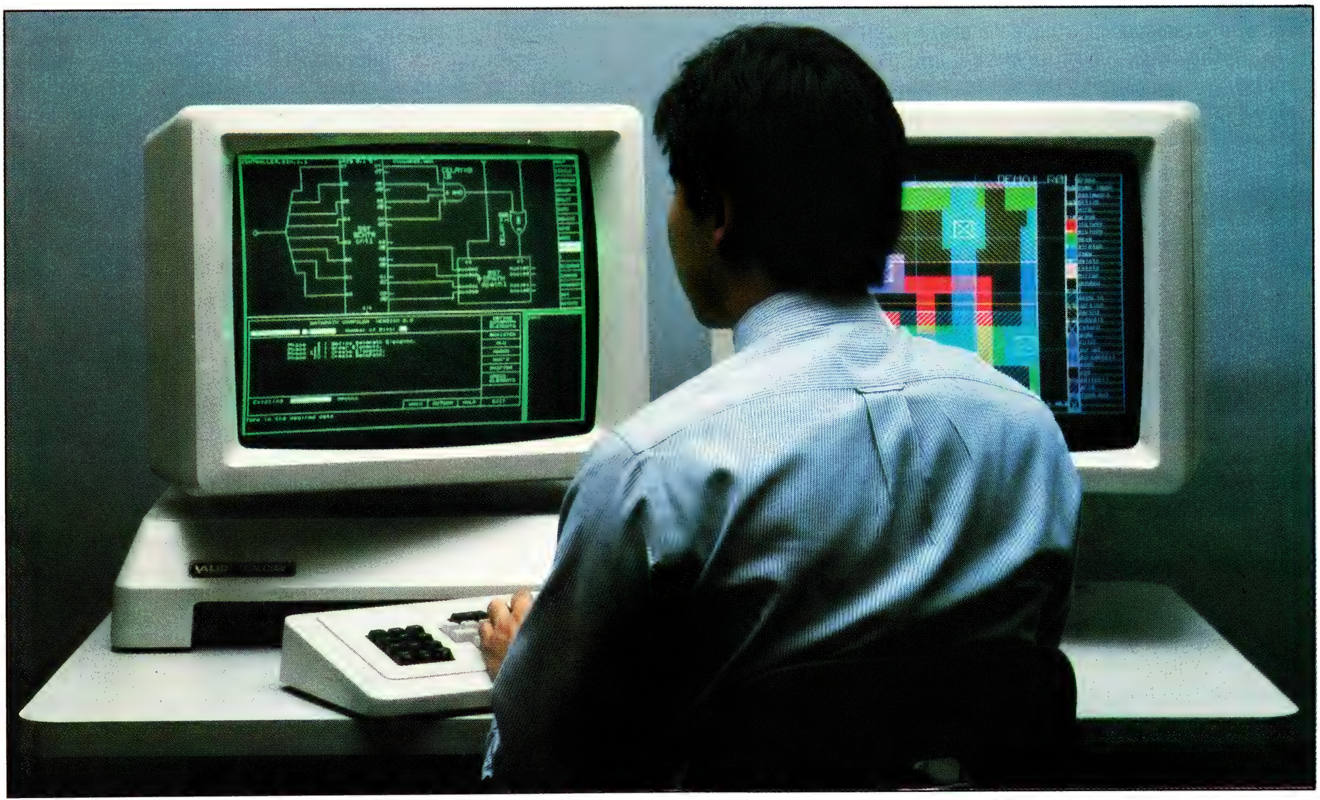
Even in the world of gate arrays, the physical-layout job is still left almost exclusively to engineers working at the silicon foundries, that is, IC experts familiar with the foibles of a given process technology. The layout tools are of course available to system-level designers outside the exclusive brotherhood of IC specialists, and it is a relatively simple matter for a circuit designer at a work station to transform his gate-array netlist into a physical layout for the chip's interconnection layer with an automatic-layout package.

But many foundries find they cannot guarantee the results of using a customer's physical layout, and very nearly all gate-array layouts are currently produced at the semiconductor house from customer-supplied netlists. In order to make layout possible for designers who are not expert in silicon design, the vendors of CAD tools are developing close relationships with the silicon houses in order to produce tools capturing the necessary process expertise.

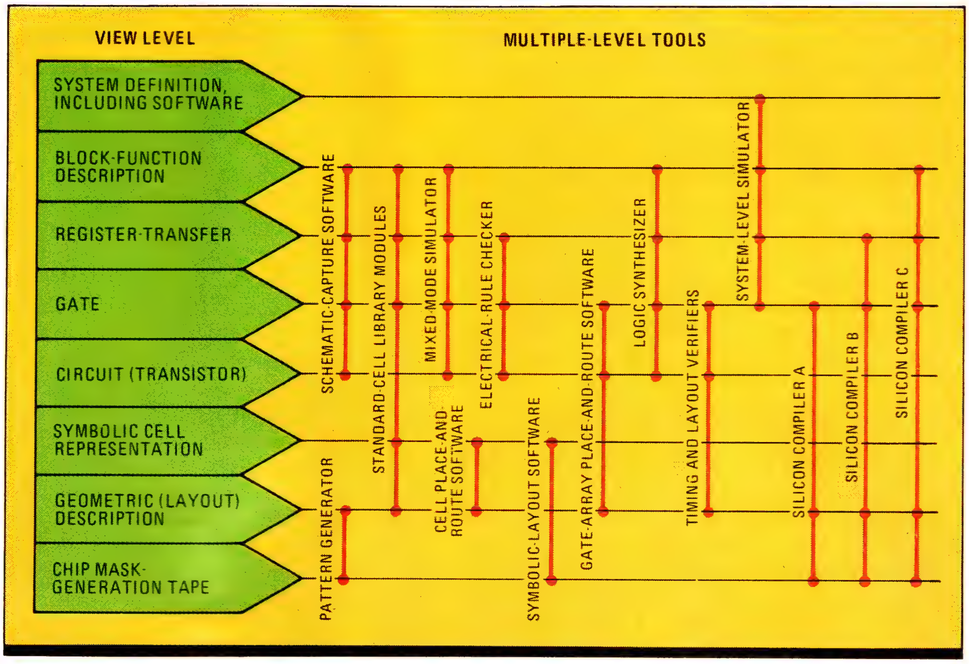
VR Information Systems Inc. of Austin, Texas, for instance, has come out with the first of its planned Turnchip modules [*ElectronicsWeek*, June 3, 1985, p. 16]. Arising from expert-system technology, Turnchip modules are rule-based routines that work with the firm's Merlyn-G layout software to fine-tune layouts generated on a circuit-designer's work station for a particular process in use by a particular silicon merchant.

Given that the current division of labor in the semicustom-IC world puts schematic capture at the systems houses and layout work still primarily at the silicon foundry, the captured schematics must be put in a form the foundries' layout systems can read. Unfortunately, there are very nearly as many netlist formats as there are engineering-work-station vendors, and the translation task is a major headache.

The netlist translation problem is one that is addressed by



2. Fitting in. Seattle Silicon Technology's Concorde cell compilers fit in among tools running in a computer-aided design environment such as that of Valid Logic's Scaldstar work station. Versions will soon be available for the Mentor Graphics Idea series and the Tektronix CAE2000.


VIEW LEVEL
MULTIPLE-LEVEL TOOLS
SYSTEM DEFINITION, INCLUDING SOFTWARE
BLOCK-FUNCTION DESCRIPTION
REGISTER-TRANSFER
GATE
CIRCUIT (TRANSISTOR)
SYMBOLIC CELL REPRESENTATION
GEOMETRIC (LAYOUT) DESCRIPTION
CHIP MASK-GENERATION TAPE
SCHEMATIC-CAPTURE SOFTWARE
PATTERN GENERATOR
STANDARD-CELL LIBRARY MODULES
MIXED-MODE SIMULATOR
CELL PLACE-AND-ROUTE SOFTWARE
ELECTRICAL RULE CHECKER
SYMBOLIC-LAYOUT SOFTWARE
GATE-ARRAY PLACE-AND-ROUTE SOFTWARE
LOGIC SYNTHESIZER
TIMING AND LAYOUT VERIFIERS
SYSTEM-LEVEL SIMULATOR
SILICON COMPILER A
SILICON COMPILER B
SILICON COMPILER C

3. Design-view hierarchy. IC designers can use software tools to view their work at highly generalized levels down through levels showing increased detail. Some tools (not shown) operate at only one level; silicon compilers let users leap from high up the scale to the bottom.

the Electronic Design Interchange Format (EDIF), the first version of which was released in March. Backed by Daisy Systems, Mentor Graphics, Tektronix, Texas Instruments, Motorola, and National Semiconductor, EDIF expresses design data in the form of a hierarchy that is detailed at its lower levels but can be highly abstract at its upper levels.

EDIF, when it is demonstrated to be a workable format, may become a standard that dictates how design data is transmitted. On the other hand, points out Andrew Rappaport, president of the Technology Research Group, much work remains to be done in defining not just how but exactly what information must be expressed in EDIF to satisfy a foundry's needs before it can implement an IC in silicon.

Silicon compilers

Silicon compilers, however, go beyond the point of netlist generation, because they automate the physical-layout task. Their output is a tape for a mask-making machine with data in a format such as the Caltech Intermediate Format.

As is often the case with new technologies in emerging markets, there is some dispute over the definition of a silicon compiler. All silicon compilers have as their stock in trade the captured expertise of silicon-design specialists, so that members of the large body of circuit and system designers can produce a chip without the aid of such specialists. The principal disagreement is on how far up the hierarchy of design views the user of the software should be able to work before the package qualifies for the title of silicon compiler. For example, the input to Chipsmith, a compiler from Lattice Logic Ltd., Edinburgh, Scotland, is a complete logic design, whether written in Model, the firm's hardware-description language, or produced as a logic diagram (for later conversion into Model code by the Draftsmith package).

If a silicon compiler is defined as a program that accepts a behavioral circuit description as input, then Chipsmith is not a compiler, concedes Peter Robertson, one of Lattice Logic's three founders and the man responsible for creating Model. But conventional compilers for software languages like Fortran or Cobol do not accept abstract descriptions of algorithms either, he points out. In other words, Chipsmith functions analogously to existing compilers for high-level software languages, and so is not improperly categorized as a compiler.

Chipsmith, which can be used to wire gate arrays but is also capable of producing a full mask set eliminating the leftover gates and interconnect space, is distributed by third parties with whom the company has signed agreements, such as Ferranti Electronics Ltd. of Oldham, England.

Silicon Compilers Inc. most of all would like the definition of a true silicon compiler to exclude such products as Chipsmith. Silicon Compilers' product allows the system designer to do extensive design exploration at the architectural or functional level. He can describe his chip as a number of functionally defined blocks and, without his decomposing the blocks into their component cells or the cells into their component gates, the compiler can model his circuit and give him approximations of the resultant chip's dimensions, performance, and power consumption.

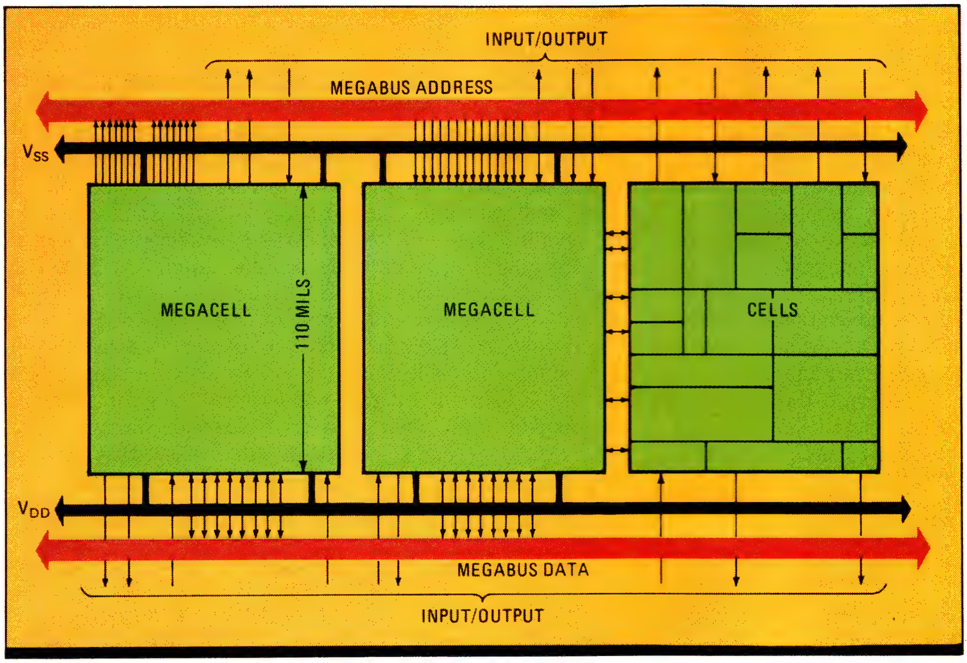
Silicon Compilers' Genesil system offers the user a set of what it calls micro-architectural-level functions, such as ALUs, programmable logic arrays, barrel shifters, and the like. These parameterized cells are defined through forms entry; a hardware language like Lattice's Model is not used, in the interest of reducing the time an engineer needs to spend learning how to use the system. (Lattice Logic originally thought Chipsmith users would prefer to work in the Model language; their customers convinced them to add Draftsmith's logic-diagram entry capability so that designers could work in a more familiar format.)

After exploring architectural alternatives, which may involve modeling a set of chips and looking at the tradeoffs presented by possible functional divisions among those chips, the Genesil user progresses into the detailed-design stage. At this time the designer can choose to override parameter defaults that he left as they were in the exploratory stage, successively refining his definition of the circuit and obtaining increasingly accurate estimates of chip performance and size (Fig. 1). Chips can be designed in CMOS (with two metal layers) or n-MOS (with a single metal layer) with geometries of 2 or 3 μm (see Table).

Earlier this month, Silicon Compilers Inc. announced two new versions of its Genesil system, one of which is based on Microvax II hardware and reduces the entry level for a Genesil system to \$165,000. This single-user system is complemented by systems for up to 10 users.

The Genesil systems are turnkey units that present the user with an integrated environment. Seattle Silicon Technology, on the other hand, produces a set of cell or module compilers that are intended for use in conjunction with graphics editors, simulators, and other software already running on engineering work stations. Originally introduced for use on Valid Logic Systems Inc.'s Scaldstar system (Fig. 2), Seattle Silicon announced this month versions of the Concorde compiler software that run on Mentor Graphics Idea-series work stations and the Tektronix Inc. CAE2000.

New Concorde tools were at the same time announced for compiling analog cells, automatic routing for all on-chip interconnections, and for designing state machines using a special language called Smile. The analog-cell compilers can be used



4. Giant cells. Entire LSI functions have been captured in huge standard cells VLSI Technology Inc. calls Megacells. To avoid wasting silicon real estate, all the firm's Megacells conform to a standard height and tie to the on-chip Megabus, which runs above and below them.

to add analog-to-digital and digital-to-analog converters, operational amplifiers, comparators, Pierce oscillators, analog switches and multiplexers, and components such as diodes, resistors, and capacitors to a chip design.

Daisy Systems Corp., which has had considerable success in marketing work stations with an integrated computer-aided-engineering environment, announced this week that it is endorsing silicon compilation. Daisy has licensed Silicon Compilers' Genesil software and has modified it to work in concert with other tools already running on the Daisy hardware, such as schematic-capture, simulation, and timing-analysis software (see p. 76).

An application-specific IC design compiled on a Daisy Logician also can be honed with the firm's full-custom geometric-layout software. A new version of this software, called Concurrent Chipmaster, was announced this week.

Compiling with behavioral input

Most silicon compilers allow hardware designers to work in a relatively familiar environment. In large part, engineers work in graphic environments, manipulating familiar types of hardware symbols at the transistor, gate, register-transfer, or block levels (Fig. 3). They move these elements around on a floor plan and connect them with wires; thus, they can think about and manipulate the hardware in much the same way they have for years.

But Metalogic Corp. of Cambridge, Mass., is offering the industry a horse of a very different color. While the other compilers on the market accept structural descriptions as input, Metalogic's Metasyn silicon compiler accepts only behavioral or algorithmic inputs.

In essense, Metasyn is a system or software engineer's silicon compiler: it requires almost no knowledge of the hardware itself, and it offers significant advantages in designing microprocessor ICs, in which the software and hardware design processes are so linked as to be almost indivisible. Metasyn allows the system designer to embody a time-critical software algorithm in hardware simply by translating that algorithm into the Lisp-like language the compiler uses as input.

Metasyn, which is based on the MacPitts silicon compiler developed at the Massachusetts Institute of Technology's Lincoln Laboratory, faces an uphill battle for acceptance by hardware designers because it does not allow them to directly manipulate hardware structures in the manner they are used to, and because it forces them to learn what is essentially a software language to describe the behavior of the IC they want. Another drawback is that Metasyn runs only on a Symbolics Lisp engine, so the price of entry is relatively high.

This spring, a startup firm called Silicon Design Labs Inc., in Liberty Corner, N.J., announced the availability of silicon-compilation technology that also deviates from the silicon-compiler norm, but in a different way [*ElectronicsWeek*, May 20, 1985, p. 21]. The firm's Generator Development Tools are aimed at automating the process of developing silicon compilers: GDT can be described as a compiler for silicon compilers, and is targeted for use not so much by systems and circuit engineers, but by the IC-design experts employed at merchant IC houses and at the captive IC-fabrication facilities of large systems houses.

GDT, which is built around a hardware-description language called L (a superset of EDIF), automates the process of capturing the IC experts' design expertise. In the parlance of Silicon Design Labs, a generator is analogous to a cell or module compiler; thus, a library of generators would be the core of a silicon-compilation environment. GDT makes it relatively easy for an IC house to capture what it feels are the specific application strengths peculiar to its IC process technology, in addition to expertise in working around what might be viewed as the technology's weak points. The IC house can then offer the generator software to outside systems designers, giving them added incentive to use the IC house as a foundry, and providing them with tools the foundry can guarantee will work with their process.

GDT is a complete environment including an L simulator and user-interface software that allows a circuit to be viewed at the transistor or gate level or at any level in a hierarchy of cells or blocks, in addition to looking at it as an L listing. It is said to be compatible with any mask-defined process technology, including n-MOS, CMOS, and bipolar. Furthermore, it allows the development of analog-circuit generators, although the L simulator is not yet modified for modeling such circuits. It is an open system that can be used in conjunction with existing circuit libraries and CAD software.

Generators developed with GDT, which runs on Sun Microsystems work stations, can be used to build a silicon-compilation hierarchy because they can pass parameters to one another. This makes possible incremental design refinement within a family of generators, points out Hal G. Alles, vice president of custom engineering at the firm, so that the software accumulates design expertise over time. Artificial-intelligence technology is also being used to capture IC-design expertise (see "IC-design tool set is built on AI foundation," p. 63).

Until recently, the largest members of standard-cell libraries were core microprocessors about which the semicustom designer could configure the required random-access and read-only memory, input/output circuitry, and glue logic for his design. But at the end of April, VLSI Technology Inc., an early participant in the commercial silicon-compiler market, introduced the first members of what it calls its Megacell line.

The firm defines Megacells as the equivalents of standard LSI functions; almost any popular LSI part is a candidate for implementation as a Megacell. But VLSI Technology does not simply import LSI designs as they are and expect to drop them into standard-cell ICs. The most intractable problem this short-cut would present the designer with is that of "megaholes." A megahole, or large area of unused silicon, appears if three large cells, each more or less square, are placed in three of the four quadrants of a square chip: the fourth quadrant contains the megahole. Other less extreme megaholes present themselves when a designer tries to combine an odd assortment of large cells with a haphazard combination of dimensions. He would feel the frustration of a mason forced to work with bricks that all had different dimensions.

VLSI Technology's approach is to redesign the LSI functions so that they all conform to a standard height (Fig. 4). Thus a number of Megacells can be lined up in an even-sided row without wasting real estate. Furthermore, the firm has designed an on-chip bus it calls Megabus, which runs above and below the row of Megacells. The cells are designed so that the connections to this bus are available on the sides of the cell where the bus passes by. The first Megacells to be made available include the VGC6845 cathode-ray-tube controller and 16-, 32-, 64-, and 128-K ROM arrays.

In May, Waferscale Integration Inc., Fremont, Calif., also added a very large standard cell to its Probe library. The 59C032 32-bit microprocessor cell, built in 2-μm CMOS, contains functions equivalent to eight 2901 bit-slice processors and three 2902 carry look-ahead devices; it runs at 15 MHz.

Foundry connections

A silicon compiler is useless unless there exists a reliable silicon foundry willing and able to work with its output. Vendors of such compilers are very much aware of this and have been hard at work developing viable relationships with IC-fabrication firms and tweaking their software to accommodate specific process technologies. VLSI Technology is alone in starting out with its own fabrication facilities.

Thus it was far from insignificant when Silicon Compilers Inc. announced in May that four foundries had agreed to accept Genesil output for IC production. The four are Gould AMI Semiconductors, International Microelectronics Products, NCR Microelectronics, and VLSI Technology.

The agreements go beyond a one-sided endorsement of silicon compilers; they represent a commitment on the part of the compiler vendor to follow the evolution of each foundry's process technology and to build into their compiler's technology files the necessary design rules. Seattle Silicon has gained the support of the same foundries plus that of Comdial Corp.

The considerable effort that Silicon Compilers invested in its foundry relationships is a testament to the fact that the foundries have been somewhat leery of compilation technology. The effect of Silicon Design Labs' GDT, if it succeeds, will be to draw foundries into the compilation game on a far more intimate basis.

Silicon Design Labs' approach "is the model that I think will succeed because it allows the foundry to provide significant value added," says Rappaport, referring to the cell compilers foundries can produce with GDT. GDT allows the foundries to continue selling the expertise of their IC-design specialists, captured in software instead of directly in silicon, in addition to the mechanical act of stamping out chips. "The problem that [Silicon Compilers Inc.] faces is that they don't allow the foundries to have any other input to the compiler except the design rules. There's less value added by the foundry, so there's less reason for them to become involved," Rappaport explains.

Of all the functions of IC-design tools currently on the market, Rappaport feels that "testability analysis is absolutely the biggest bottleneck in the process. The more complex the chips become, the more internal nodes they have that are difficult or actually impossible to test by applying patterns to inputs and watching the outputs. And the fault-simulation task, in which a set of test patterns is analyzed to determine the percentage of theoretically possible faults it will identify, becomes an increasingly computation-intensive job.

Cadat is a popular fault simulator that is licensed by work-station vendors Applicon, Cadam, Cadnetix, Futurenet, Mentor Graphics, Racal-Redac, and Via Systems, among others, and that is used to generate test-pattern tapes for a number of automatic test systems. HHB Softron of Mahwah, N.J., which developed Cadat, has produced versions that take the big computation job to mainframes and superminicomputers, in addition to the work stations it runs on. The more computation power that is applied to the simulation, the more of the space of possible faults it can explore, points out Todd Westerhoff, product marketing manager for Softron.

Softron's attempts to reduce the load on a customer's computers include improvements in the Cadat algorithm, as well as a system introduced in February. The Cats integrated simulation engine, as it is called, is a Sun Microsystems work station with an added hardware accelerator designed to execute the Cadat algorithm. Westerhoff says the Cats box runs Cadat fully 1,000 times faster than a VAX-11/780.

But throwing even endless simulation at VLSI chips does not alter the fact that some faults simply cannot be detected without some way of probing inside the chip. IBM Corp. and the Department of Defense have been developing level-sensitive scan design as a solution. This technique calls for a connected string of shift-register latches to be scattered throughout an IC's logic to allow the state of internal circuits to be captured and read out [*Electronics,* Nov. 8, 1979, p. 116].

But the silicon real-estate penalty for this scheme, depending on how far it is taken, ranges from about 5% of the total chip area to more than 20%; this is a price only IBM and the DOD have shown themselves willing to pay. So the problem remains a major one. The single saving grace of silicon circuit implementations, according to Westerhoff, is that the most common types of flaws affect numerous devices in the area of the problem, substantially increasing the likelihood that the vendor's test patterns will detect them.

Another simulation engine just announced this month for first deliveries in July is the Spicengine from Shiva Multisystems Corp., Menlo Park, Calif. This system, based on a parallel computer from Sequent Computer Systems Inc. and one or more special accelerator boards, is designed to execute Power-

SILICON COMPILERS SUPPORT A VARIETY OF PROCESS TECHNOLOGIES

Silicon compiler vendor	Hardware environments	Supported process technologies
Silicon Compilers Inc.	DEC VAX family, Daisy Logician	2- and 3-μm double-metal CMOS and single-metal n-MOS
VLSI Technology Inc.	Apollo-based VLSI Design System	3-μm double-metal CMOS, 3-μm n-MOS (HMOS)
Seattle Silicon Technology	Valid Logic Scaldstar, Mentor Graphics Idea series, DEC VAX, Tektronix CAE2000	3-μm single- and double-metal CMOS
Lattice Logic Ltd.	DEC VAX, IBM 4300, Perkin-Elmer 3200, Whitechapel MG-1, Apollo Domain, Sun Microsystems stations	2.5-to-5-μm single-metal CMOS, Ferranti Electronics Ltd. collector-diffusion-isolation bipolar gate-array process
MetaLogic Corp.	Symbolics 3600	3- and 4-μm single-metal n-MOS

spice, a refinement of the Spice circuit-simulation program from the University of California at Berkeley. Powerspice software by itself, running on a VAX superminicomputer, is said to run three to five times faster than Spice2 on a similar VAX and to produce more accurate results. With the SX-series engines, selling for $125,000 to $350,000, simulations run from 20 to 100 times faster than Spice2 on a VAX-11/780.

Jeffrey Deutsch, Shiva's chief technical officer, says the system's speed makes simulation-based circuit optimization over temperature and process variations a practical reality. Circuits are broken down into subcircuits for the simulation, and multilevel relaxation algorithms allow the simulation to concentrate on portions of the circuit that are changing more rapidly than others. Internally, Powerspice is a mixed-mode simulator, but its input and output are at the circuit level for compatibility with Spice input parameters and output formats.

New full-custom entries

Despite the fact that full-custom geometric-layout IC design systems are expected to represent a dwindling portion of the overall CAD market, new companies are setting out to grab a slice of Calma's (and Applicon's) pie. One, SDA Systems of Santa Clara, Calif., introduced its first product in February.

The product, called the Framework system, provides a graphics command interpreter, window manager, graphics manager, and data manager that operate in a uniform fashion across a wide range of tools. The system's unified data base holds all information pertaining to a circuit design, making unnecessary any data translations in moving from schematic capture to circuit or logic simulation to physical layout.

Similar levels of tool integration and human-interface consistency are claimed for a full-custom system scheduled for announcement this month. Developed by Clarity Ltd., a two-year-old firm based in Herzlia, Israel, and with offices in Sunnyvale, Calif., the system runs on Apollo Domain work stations and can take advantage of a computation server on an Apollo network to execute computation-intensive tasks. To an initial set of schematic-capture, layout, and simulation tools, Clarity expects to add a library of cell compilers.

All the way at the other end of the spectrum from systems that concentrate on the nuts and bolts of geometric layout are the system-level simulation packages. One such simulation package that has emerged from its academic spawning ground (at Case Western Reserve University) into the commercial world is N.2 from Endot Inc. of Cleveland.

The second generation of a system-design tool set originally called N.mPc, N.2 began reaching users' hands in May. Capable of modeling a complex system using behavioral descriptions as input, N.2 permits software development for a system to begin long before any actual hardware is put together. High levels of system complexity can be dealt with in its hierarchical modeling environment.

Originally intended for designing multiple-microprocessor systems, the use of N.2 and its predecessor has focused increasingly on VLSI design, according to Endot. N.mPc was used by Motorola to validate the microcode and diagnostics for the 68010 microprocessor, and it has been used for architectural development and validation of other processors, such as a vector-processor chip set produced under the DOD's Very High Speed Integrated Circuits program.

The new version moves the simulation from its original PDP-11 environment onto VAX-series computers. This has made it possible for Endot to consolidate numerous modules of the system and simplify its operation. The new version allows users to define interconnections at all levels of the design hierarchy instead of just one level, and new emphasis has been placed on the graphics-based interface.

At the core of N.2 and similar simulation environments under development at academic and industry research labs is a hardware-description language. Lattice Logic's Model and Silicon Design Labs' L are examples of such languages. Ella is another hardware-description language and simulation tool set that has just emerged from the research facilities of the UK's Royal Signals and Radar Establishment to be commercially supported by Praxis Systems Ltd., Bath, England.

Some hope for a standard among such languages emanates from a project being undertaken by IBM, Intermetrics, and Texas Instruments under a VHSIC contract. VHDL, for VHSIC hardware-description language, supports the design, documentation, and simulation of hardware from the system level to the gate level. Ada-language constructs are used in the technology-independent language wherever possible, and user-definable data types add flexibility. VHDL supports both procedural (algorithmic) and nonprocedural, data-flow-oriented descriptions of hardware.

A part of VHSIC phase 2, VHDL will speed up the insertion of new submicron technologies, it is hoped. VHSIC chip contractors are to describe their designs in the language so that they may be verified by the VHDL simulator. Other contractors are to accept VHDL chip descriptions, along with other documentation, for use in the production of chips. The Integrated Design Automation System program, now under way at the DOD, has been chartered to develop a set of design-automation tools centered on VHDL. ☐

IC-DESIGN TOOL SET IS BUILT ON AI FOUNDATION

Artificial-intelligence technology is being brought to the IC-design automation arena by Carnegie Group Inc., a Pittsburgh firm founded by professors from the Carnegie-Mellon Institute. The company is currently negotiating with work-station vendors to supply their logic synthesizer, called DAS/Logic, on a value-added-reseller basis. Their AI technology provides an alternative Silicon Design Labs' GDT for capturing circuit- and IC-design expertise in software.

Logic synthesizers offer a subset of the capabilities of silicon compilers. They accept design input at the functional-description or register-transfer level and synthesize a gate- or circuit-level implementation of the function, which can then be carried into layout form by other tools.

DAS/Logic uses expert-system rules to guide the user-interactive process of logic synthesis. The user is asked to enter information on timing requirements and constraints on performance, power consumption, and cost, in addition to the functional description of his circuit. DAS/Logic's function is further constrained by rules fed it by another Carnegie tool, DAS/Signal-analysis. This program accepts a topological description of an electrical network, which can describe either circuit-board or IC physical parameters. Other inputs are Spice models of drivers and loads, and design criteria for acceptable noise margins and delays.

DAS/Signal-analysis uses these inputs to generate design rules for DAS/Logic covering bounds on wire lengths, line termination, and driver and load characteristics. When it is ready, these rules will also be used by DAS/Layout, which accepts the logic design put out by DAS/Logic and assists a designer in the generation of geometry-level artwork for a chip. All of these tools (Carnegie has several under development) are expected to make the transition much easier from one circuit technology to another, because the tools themselves do not have to be rewritten to adapt to substantially different technologies. Only the rules that drive them need be changed. **–J.L.Y.**

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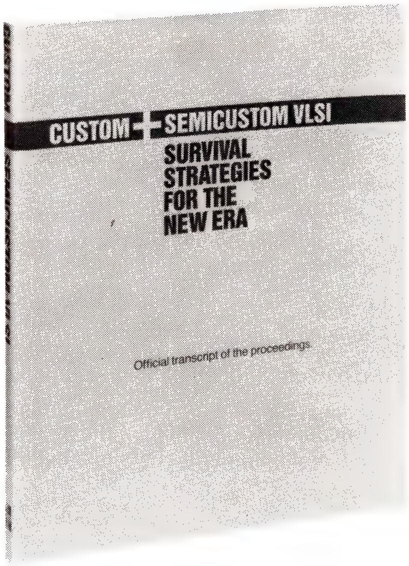
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ERASABLE OPTICAL DISKS ARE ON THE HORIZON

VERBATIM TO UNVEIL 40-MEGABYTE MAGNETO-OPTICAL DISK AND DRIVE SYSTEM AT NCC THAT USES FARADAY EFFECT

Among all the mass-storage systems being displayed at this year's National Computer Conference in Las Vegas, one of the brightest contenders is certain to be optical-disk technology. Because optical disks can offer more than 20 times the information density of current magnetic storage devices at a lower cost per byte, these disks have long been touted as the next revolution in mass storage.

The technologies for read-only and write-once versions of optical disks are well in hand, but what has proved most elusive to optical-disk developers is the formula for an erasable optical disk. That's why some excitement is anticipated over a working laboratory prototype of a 3½-in., 40-megabyte (formatted, 47 unformatted), erasable, removable magneto-optical disk and drive that will be unveiled at the show by Verbatim Corp., Sunnyvale, Calif.

The mass-replicated read-only optical disk—which shares much of the engineering used in digital audio disks—is expected to become the favored storage medium for such large database distribution chores as stock-market histories and patent libraries. Write-once drives that use a modulated laser beam to permanently engrave a submicron-sized bubble or pit in the active layer of the medium may well supplant microfilm and magnetic tape as the archival medium of choice for bank transactions and medical records.

Up to now, the search for an erasable optical disk has centered on both phase-changing media and magneto-optics. By varying the heat applied to the active layer of a disk, backers of phase-changing media say, it should be possible to control the localized reversal of states between amorphous and crystalline, enabling the sensing of the relative reflectivity between the states, using sensors based on the Kerr effect. On the other hand, the magneto-optical approach, based on the Faraday effect, is favored by more than 13 companies including Verbatim.

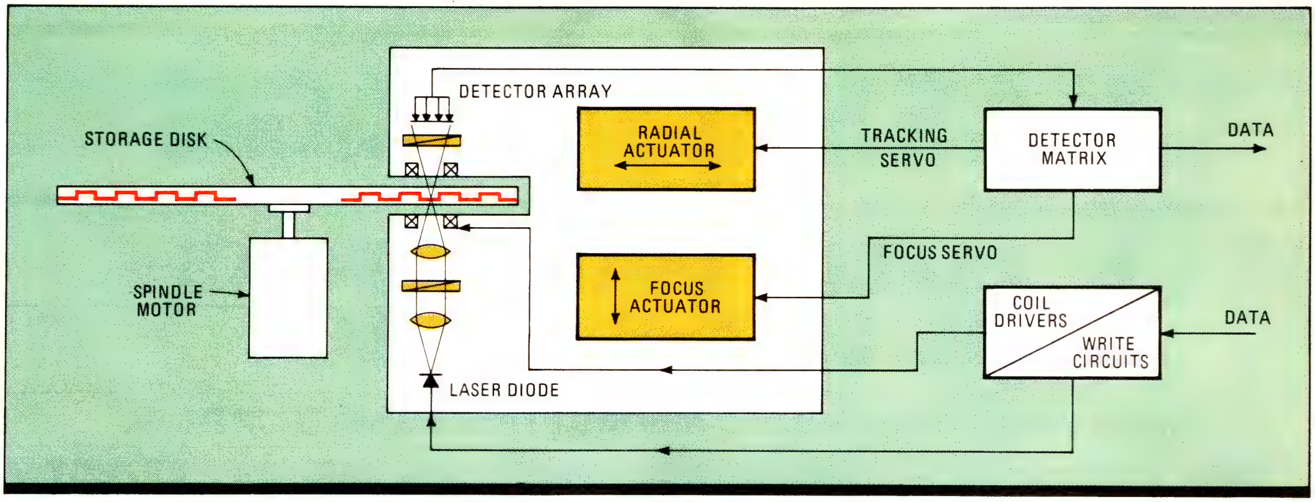
With only three weeks left before the NCC, the Verbatim development team is working the bugs out of its demonstration unit, which uses an IBM Corp. Personal Computer. By showtime it expects to be ready with a 3½-in. disk and drive with the same footprint as a 3½-in. microdisk drive. Although team leader Geoffrey Bate, senior vice president of research and development, is quick to point out that the demonstration prototype is "not a product precursor," there is no doubt about where the company is headed (Fig. 1).

After some 15 months of intense R&D effort, the demonstration will represent the payoff from an $800,000 gamble, and heralds the start of Verbatim's product-development push. The project has high visibility and motivation within the company. "It's a big challenge to commit to this kind of technology," says Bate. "There is a great penalty for failure."

Though Bate won't talk much about Eastman Kodak Co.'s takeover of Verbatim last March, he does say, "It hasn't hurt our project at all. In fact, they've been very encouraging." Kodak's Spin Physics Division in San Diego is active in developing perpendicular magnetic recording as an alternative technology for increasing the density of conventional mass magnetic storage.

1. Eraser head. Investing nearly $1 million just to develop a prototype 3½-in. erasable optical disk is risky business, says Verbatim vice president Geoffrey Bate. But Kodak's recent takeover of the firm may have cut the odds in Verbatim's favor, since Kodak brings much materials-science expertise to the company's effort.

In magneto-optical recording, the active layer of the disk is



2. Faraday effect. A laser diode and detector array ride on opposite ends of the U-shaped assembly that encloses the disk's surface. When a low-power polarized beam is focused on a magnetic domain, the Faraday effect rotates the beam, which is picked up by the analyzing filter and photodetector on the top surface of the disk. Using the Faraday effect instead of the Kerr effect results in a less expensive device.

uniformly magnetized in a direction perpendicular to the plane of the substrate. To write, an electrically modulated laser beam is focused on a 2-μm spot of the active layer. Because of the special properties of the active layer, the beam raises the temperature only in the spot being irradiated, thus making the properties of the magnetic domains susceptible to reorientation.

In most cases, Curie-point reorientation occurs at about 200°C. A magnetic coil working with the laser can thus easily reverse the polarity of the domains by applying a bias field of just a few hundred oersteds and allowing it to cool, which typically takes only about a microsecond. To erase a bit, the process is repeated but the field direction is reversed. Overwrite involves first doing an erase, then waiting a revolution before writing again.

U-shaped assembly

In the Verbatim system, the gallium aluminum arsenide laser diodes (supplied by Sharp Corp. of Osaka, Japan) are mounted below the disk, and the detector array rides above the disk on a U-shaped assembly (Fig. 2). To read, a low-power (3-mW) polarized beam is focused on a magnetic domain. Because of the Faraday effect, the polarization angle of the light rotates as it passes through the film. The rotation is picked up by the analyzing filter and passed to the photodetector on the top surface of the disk. A radial actuator moves it along the disk and a focus actuator maintains track registration. For writing, the beam power is increased to 10 mW.

Track registration and focus is accomplished by the U-shaped ultraprecision assembly, which carries the laser and four photocells. The photocells register diffraction as laser light is split into a main beam and two weaker ones by either the grooves or lands which are preformed on the disk to define the tracks. If the laser is on track, the diffraction is equal across the four detectors. When the detectors register an unequal signal, this error signal is used to correct the tracking path and refocus the beam.

Unequal signals reveal that the beam is off track or out of focus and tell the drive how much the lens must be moved to correct the errors. The process of detection and correction of the position and state of focus of the light beam happen continuously and automatically when it is in the drive. The grooves in the disk that make possible the auto-tracking and auto-focusing are molded into the transparent plastic of the optical disk before the thermo-magneto-optic film is deposited.

Audio compact disks already use the diffraction technique and typically achieve 12,000 to 15,000 tracks/in. Verbatim plans to use a 4-μm track, making possible 6,350 tracks/in. But track densities could be pushed further, says Ingolf Sander, the project leader, all the way to a 15,000-tracks/in. pitch. "Low cost is more important right now, and to design a drive which could read such densities would be much more expensive and yield would be much lower," says Sander.

Verbatim claims that the disk is capable of tens of millions of flux reversals, since there is no way to wear it out. Coercivity of the media is typically about 2,500 oersteds at room temperature, but drops to just 150 Oe when irradiated. A bias field of 200 Oe is applied to establish a baseline polarity. At room temperature, such a weak field is insufficient to switch the medium, Verbatim says.

Bate says that the danger of information inadvertently being destroyed is no more likley to occur than with traditional magnetic disks. He says that the sequence of events would have to involve simultaneously applying heat and a magnetic field to the film, which is unlikely unless the disk is being intentionally erased.

For the next two years, Bate and his team expect to be wrestling with problems of moving the prototype three-layer sputtered disks into production (Fig. 3). The goal is to begin large-scale manufacturing in the third quarter of 1987, selling drives for $300 and removable disks for $20 to $30 to original-equipment manufacturers.

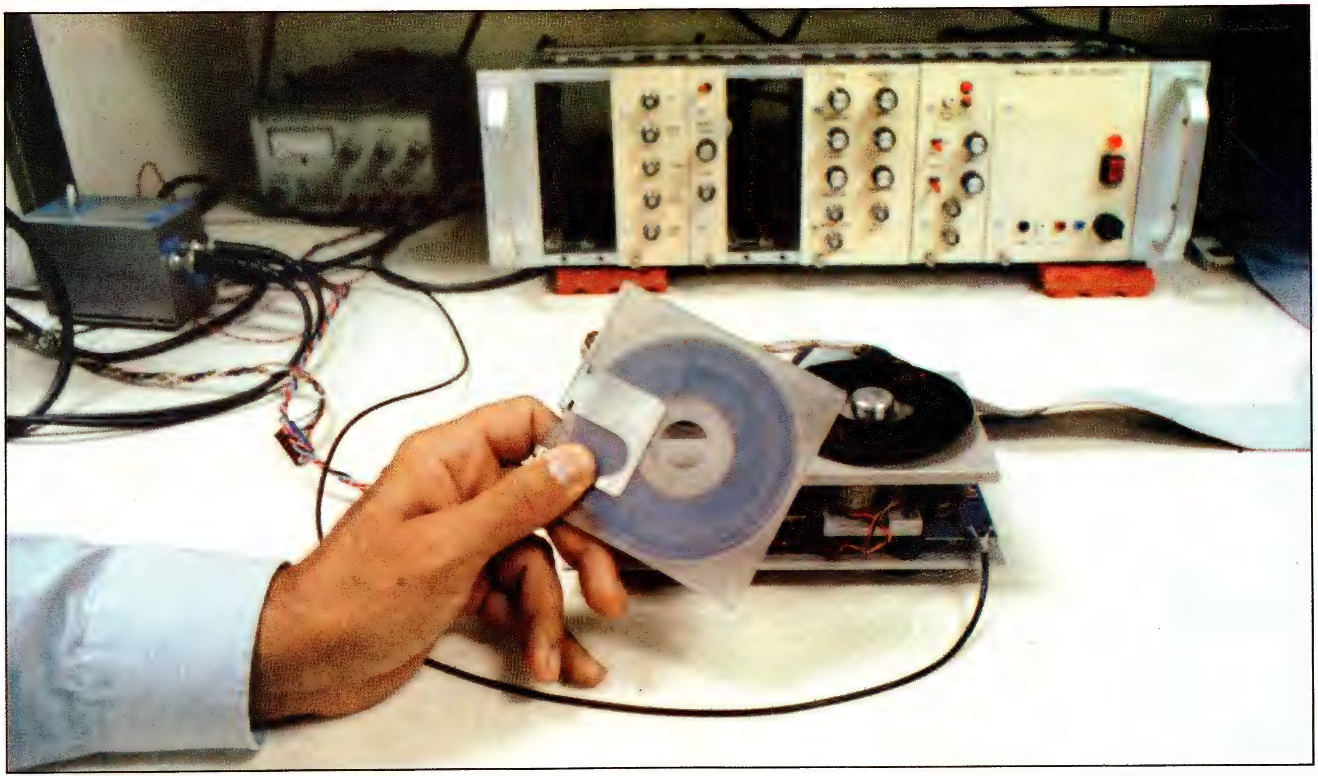
Selecting the 3½-in. form factor "wasn't a hard decision to make," says Bate, adding that he expects it will become standard in regular magnetic-disk media. He also believes the 40- to 100-megabyte formatted capacity to be adequate for personal computer storage, even by 1987 standards.

Favoring terbium

Verbatim has picked the medium's composition, but substrate technology is far from settled. The disk's active layer is a proprietary mix of terbium, iron, and cobalt (TbFeCo) that is currently being sputtered onto a glass substrate about 600 to 800 Å thick. Verbatim plans to switch to the more durable, less expensive plastic substrate as it becomes available.

Bate recalls that a similar alloy mix in its amorphous form was developed by IBM Corp. in the mid-1970s for bubble memories. It was Japanese researchers, however, who saw the importance of this class of materials to magneto-optical recording.

"The Japanese jumped on it and they developed it for optical recording," says Bate. "Now the wheel has come full circle—we're starting with these materials and changing them for our needs."



3. Development push. Verbatim expects to take two years to move the three-layer sputtered disks into production. Its goal is to begin large-scale manufacturing in the third quarter of 1987, selling drives for $300 and removable disks for $20 to $30 to original-equipment manufacturers.

Verbatim is not the only company betting on TbFeCo as the key to an erasable optical disk; one knowledgeable source counted about 20 Japanese companies also working with the alloy. But "how much of each element is the key," according to Bate, who claims that Verbatim has found the optimum combination. "Anyone who tried would have difficulty replicating our concentrations," he says.

The active layer of the erasable disk is protected by a sandwich of 600-Å-thick layers of an insulating material similar to silicon dioxide. The protective layers keep corrosives—such as water vapor and chlorine ions in the atmosphere—away from the TbFeCo storage material. It also doubles as an antireflection device. Although precisely how long the disk will last is not known, Bate says similar overcoats have been extrapolated to last 30 to 50 years.

Flying-height advantage

A major advantage of magneto-optical recording arises from the fact that it combines very small magnetic domains with a head technology that is practically immune to crashes. Verbatim claims to be recording 15,825 b/in. at a track density of 6,350 tracks/in. The detector array of the Verbatim drive rides 1,000 μm above the disk; even the most advanced Winchester disks typically fly at heights of 0.25 to 0.5 μm. "Magneto-optics gives you much greater room to play with," observes Bate.

By using the Faraday principle to read the disk, instead of the popular Kerr effect, which uses reflected light, Bate says he can build a less expensive device. Though this means that the disk can be used only on a single side, it gives acceptable access rates on a 3½-in. disk, although it probably would not be with a larger form factor.

Verbatim says track-to-track access takes about 1 millisecond, and the average from a track to any other about 35 milliseconds. By the standards of large Winchester disks, such times are not impressive, but are comparable to the standards of small Winchesters.

Much of the effort during the next two years will focus on bringing disk-manufacturing processes to commercial reality. To produce an inexpensive pregrooved disk, two alternatives are being considered, but both are fraught with technical difficulties. A plastic layer bonded to a glass substrate and molded with the pregrooved pattern is being readied for the show, but glass is expensive and easily broken, even in a protective jacket.

An alternative likely to be available when Verbatim is ready for production is an injection-molded plastic substrate impressed with the pregrooved pattern. Japanese companies such as Daicel Chemical, in Sakai City, are showing real progress in developing such a substrate, and U.S. companies are also expressing interest in the technology.

Right now, though, Bate says the company is making no commitment and will give serious consideration to both substrates, adding that a pregrooved substrate plays an enormous part in getting the disk into high-volume production.

With the technology at hand, sputtering is the favored method to put both active and protective layers onto the pregrooved disk. Verbatim says it is sputtering eight disks a day and in a year it hopes to push throughput to 50 to 100 per hour. Full-scale production plans call for a yearly production of 1 million to 2 million disks.

Bate says sputtering technology is still considered very expensive, so Verbatim is looking at alternatives such as chemical- or electroplating. "We'd prefer to find an alternative to sputtering because of both expense and throughput," explains Bate, but he concedes that plans call for the manufacturing process to be built around sputtering.

Verbatim acknowledges that there are still several sizable technical hurdles to overcome, as well as the high cost of sputtering. Access time must be made comparable to high-end Winchester technology. Slow data-rate transfers must be pumped up. To increase the present 1-Mb/s transfer rate to an acceptable 5 Mb/s, the coil-current reversal rate must be improved. Bate says Verbatim "intends to be leading the way with that technology" and with the backing from Kodak, it may well succeed. □

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LIGHT-ASSEMBLY MODELS TAKE CENTER STAGE AT ROBOTS 9

A roundup of new offerings reflects big changes in the automation industry

Although robots have been around since the early 1960s, it is only recently that light-assembly models have begun to come into their own. Fueled by the declining cost of computing power and the pioneering investments in robotics by heavy industries, light-assembly robots are not only emerging as a distinct segment but are also spreading more quickly than their bigger, and older, forebears.

Although the number installed to date is small, this segment will have the greatest growth, market watchers predict. By 1986, robot watchers such as venture-capital firm Hambrecht & Quist and the Robot Institute of America are predicting that light-assembly robots will make up 40% of the market, up from only 3% in 1982. The entire robot market, which was just $100 million in 1980, will leap to $2 billion in 1990, of which $1.1 billion will be assembly robots.

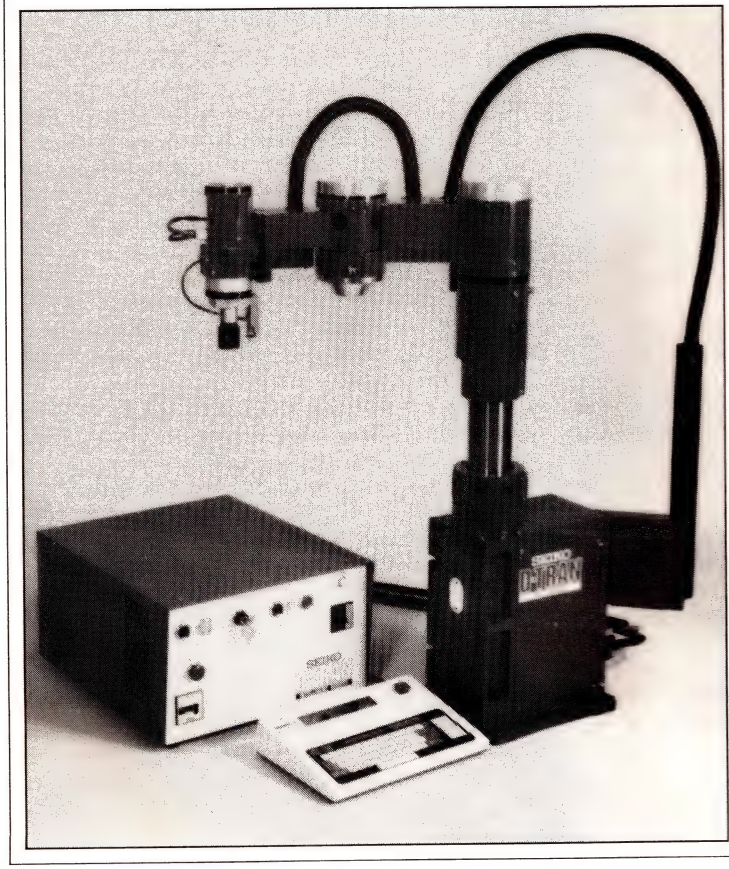
Manufacturers of these robots are devoting a great deal of their efforts to a handful of key semiconductor-manufacturing applications, which include handling silicon wafers in clean rooms; placing surface-mountable devices or inserting odd-shaped components in pc boards; operating test instruments such as in-circuit testers; and assembling personal computers, radio sections, and microwave equipment.

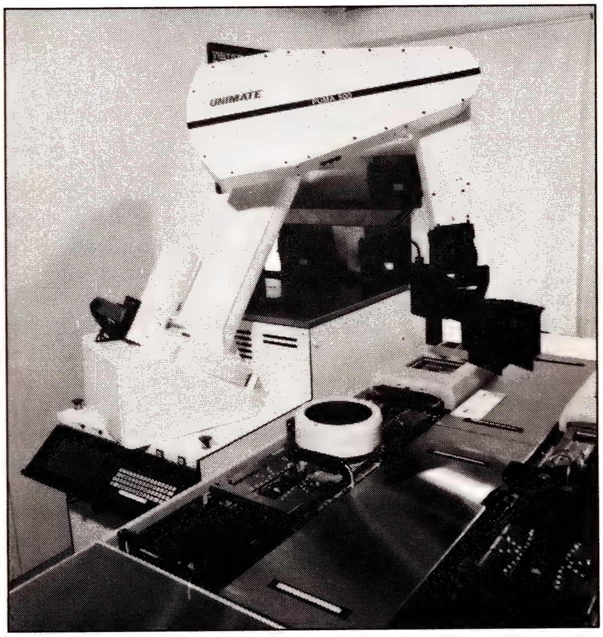
Significant inroads into this wish list of tasks were in evidence at the Robots 9 Exposition and Conference held earlier this month in Detroit, among a number of introductions geared to more heavy-duty applications, such as automobile manufacturing. In addition, some manufacturers modified their existing systems or added such intelligent features as vision systems.

Seiko Instruments U.S.A. Inc., for example, showed two models that, with their compact wrist design, can handle delicate parts with precision. The TT 2000 and TT 3000 both have their vertical (Z) axes located in the shoulder joint. The TT 3000 carries a 5.5-lb payload and its high-torque A-axis flange mounts up to four tools and maintains a repeatability tolerance of ±0.002 in. With a 2.2-lb carrying capacity, the TT 2000's compact, narrow A-axis spindle mount can master delicate moves in close quarters and is repeatable to ±0.001 in.

Good news. For semiconductor manufacturers, perhaps the best news is the number of robots that can work in clean rooms. Fitted with a clean-room fabric suit, Microbot's Alpha II exhibits particle-shedding test results (particle size being 0.2 μm or larger) of 0.11 particle/ft^3 of air. This is well within the Class 1 clean-room specifications of Federal Standard 209B. The reading is an average of all joints in all positions of motion. In actual wafer handling, the arm would be oriented only in positions that would minimize the possibility of debris falling on wafers, says Microbot.

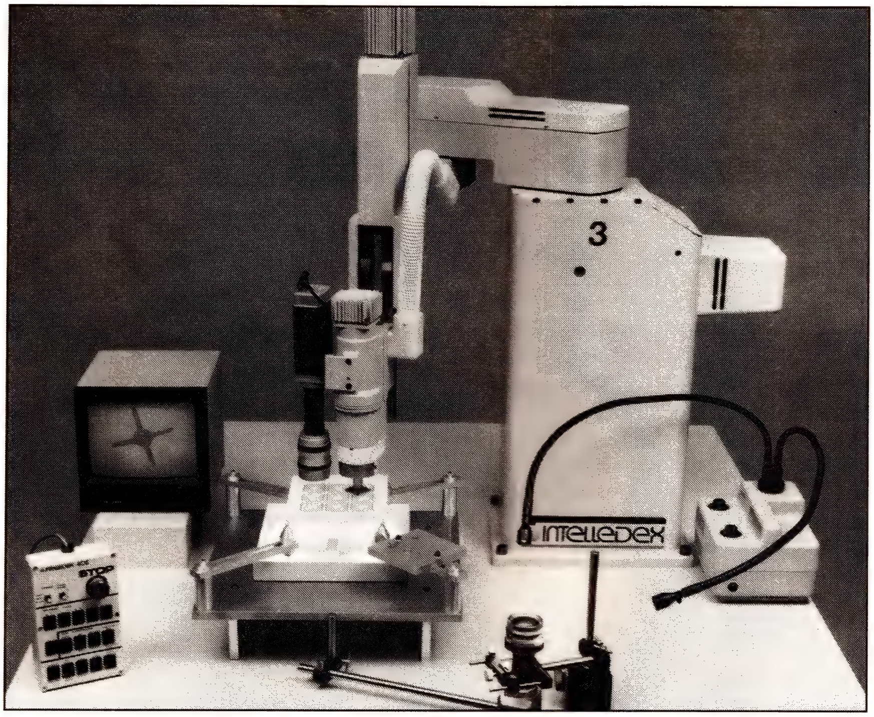
Because robot suits have not been successful in the past, Microbot's president, G.W. Rhodes, says, "After extensive tests and further refinements, we arrived at a successful combination of special tailoring and attachments. A six-month test run of over 2 million move cycles with no fraying or





Squeaky clean. Major modifications, including a specialized fan within the robotic arm to create a vacuum-like effect, qualify Unimation's Puma series 560 (above) for use in a Class 10 clean room. The robot emits fewer than 25 particles per minute.

Close quarters. Its compact post design permits the D-TRAN robot (left) from Seiko to master delicate moves in tight spaces. The vertical, or Z axis, is located in the shoulder joint.



The eyes have it. Dual cameras aid Intelledex's four-axis model 405 robot in placing surface-mountable devices on pc boards without the need for expensive fixturing.

deterioration of the fabric has now been completed."

The Microbot Alpha II is offered either as a stand-alone robot or incorporated into a wafer-transfer system called the Microbot Wafermover. Prices of the Microbot robots start at $13,900; the Wafermover system costs $16,200.

The Wafermover, a portable, adaptable wafer-handling system, itself can stand alone for semiconductor making or perform as a subsystem for semiconductor-equipment manufacturers. The robot arm sits atop a compact pedestal that houses its microcomputer and vacuum control systems. Also included are vacuum attachments for picking up different sizes of wafers in various process environments.

Cuts inventory. According to Rhodes, the system can help implement the just-in-time manufacturing technique. "Processing individual wafers instead of cassette lots within a processing area will reap surprisingly large cost savings in work-in-process inventory," he says, citing one customer that reduced in-process inventory from 120 to 7 wafers.

Elsewhere, Unimation Inc. has modified its Puma series 560 robot for Class 10 clean rooms. Adaptation of the Puma series involved internal changes and design modifications to the robot arm. These include a specialized fan to create negative air pressure (a vacuum-like effect). Air flows into the robot arm through the joints and special channels in the wrist. Unimation's engineers bored ports into link castings and joint shafts to facilitate high-volume air flow through the arm links.

Also, arm covers and access plates were reinforced. Motors are sealed and exhaust air from the fan at the robot's base is filtered through a 0.3-μm 99.9% high-efficiency particulate air filter. Tests showed the robot produced fewer than 25 particles (0.5 μm or larger) per min.

Some manufacturers have reconfigured their robots for new assembly applications. Intelledex has modified its model 405 for automated placement of surface-mountable devices on pc boards. The 405, introduced last year, is a four-axis system for inserting odd-shaped components into pc boards. The new placement system consists of the 405 guided by Intelledex's Intellevue 200 vision system. The system performs three distinct vision tasks, using two cameras, that assure accurate placement and cut the need for expensive fixturing.

One camera determines the orientation of the entire circuit board and each individual placement position on it, while the second camera checks the device after the robot grasps it to determine the orientation of the part in the robot's gripper.

In addition to modifications for use in clean rooms, Microbot and Unimation robots can now dispense liquids. Microbot's Alpha II Robotic Dispensing System automates such pc-board-manufacturing tasks as solder masking prior to conformal coating as well as dispensing such materials as thermal grease, silicones, solder paste, adhesives, lubricants, and potting compounds.

The heart of the system is Microbot's new proprietary software that enables users to set up and store new masking patterns quickly. A joystick positions the robot arm at relevant points, where one of a number of preset patterns—block, circle, line, or point—can be placed.

For dispensing liquids, the system can move up and over components on stuffed boards and tilt its needle to dispense around the base of components. The system, which sells for $24,950, can dispense on assemblies measuring as large as 24 by 48 by 18 in.

Unimation's Puma model 762, a six-axis robot with a 49-in. reach and a 44-lb payload capacity, can be equipped with its Flowmate system. When extruding, the Flowmate sealant-dispensing system can produce a uniform bead even as the robot's speed changes by a factor of 60:1. The flow rate can be varied as much as 128:1, which allows real-time control of robot travel speed and bead dimensions to a degree not previously attainable, Unimation says.

The Flowmate system uses Unimation's proprietary Unispray nozzle, which features a 5:1 flow-rate range and dispenses a consistent ribbon pattern with no overspray. The nozzle does not need to be in any special orientation—it can even spray upside down. Beads from ⅝ in. to 6 in. can be produced by varying the nozzle's distance from the surface.

Another new robot from Unimation can also dispense sealants. Called the Puma model 761, it has a smaller payload (22 lb) but a larger reach (59 in.) than the 762. Orders are now being accepted for the 762, while the 761 will be available later in the year.

Seeing robot. Designed for assembly robot guidance, Hitachi's model HV/R-1 vision system recognizes shapes, locations, and the orientation of randomly positioned pieces and transmits this data to the robot controller. What is unique about Hitachi's system is that it is integrated with the robot's coordinate system, which eliminates the need for the additional support software that is often required for vision-guided robot applications. The system consists of a solid-state camera, operation panel with a 9-in. CRT, and free-standing control unit. The HV/R-1 is easily interfaced through an RS-232-C port with a standard Hitachi assembly-robot controller. Programming is done through the use of a read-around menu-driven CRT that displays images, graphics, and alphanumeric characters. Image-processing time is less than 1 second per picture.

Despite the strong growth projected for light-assembly robots, a number of companies introduced heavy-duty robots. One of the most ambitious companies with new products was Cincinnati Milacron, which introduced two robots aimed at the automotive industry. The T^3 786 all-electric robot has a 200-lb payload capacity. The machine moves at 25 in./s, with repeat-

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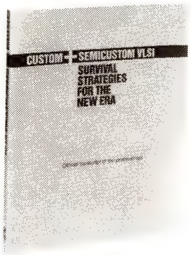

ability to ±0.010 in. The T^3 786 uses Milacron's compact three-roll wrist to provide full six-axis dexterity. For speed and precision, each axis is powered by a separate dc motor drive, monitored by separate servo devices, and equipped with a separate electric brake.

A low-cost material-handling robot, the T^3 373 is an economical solution for shops requiring a payload-handling capability in the 22- to 110-lb range. The T^3 373 features an economical cylindrical configuration with two linear axes and one rotary axis. An optional fourth axis—pitch or yaw—can be added at the end of the robot arm. Repeatability for the T^3 373 is specified at ±0.020 in. The T^3 373's work envelope is 54 in. or, optionally, 72 in.

Featuring ballscrew drives for upper and forearm axes, Hitachi's new six-axis M6060 robot has a 55-in. reach and a 13.2-lb carrying capacity. The robot uses the same type of continuous path controller that Hitachi uses in its other industrial robots.

Seiko's D-Tran RT 5000 servo assembly robot has a work envelope about 250% greater than the firm's smaller models. The robot achieves precision repeatability of ±0.0016 in. and increases horizontal stroke to 20.27 in., double the current stroke of the smaller RT 3000.

According to the company, manufacturing personnel now have an alternative to dedicated automation for larger-area or large-sized precision mechanical or electronic assemblies. With the flexible RT 5000, for example, 18-by-24-in. pc boards can be populated. The RT 5000 features a ±999° A-axis compatible with standard Seiko Multi-Grip tools and a new single-phase controller.–*Steve Zollo*

ROBOT BUILDERS

Seiko Instruments U.S.A. Inc., Robotics Division, 2990 W. Lomita Blvd., Torrance, Calif. 90505.
Phone (213) 530-8777 [Circle reader service number 400]
Microbot Inc., 453-H Ravendale Dr., Mountain View, Calif. 94043.
Phone (415) 968-8911 [Circle 401]
Unimation Inc., Shelter Rock Lane, Danbury, Conn. 06810.
Phone (203) 744-1800 [Circle 402]
Intelledex, 4575 S.W. Research Way, Corvallis, Ore. 97333.
Phone (503) 758-4700 [Circle 403]
Hitachi America Ltd., 50 Prospect Ave., Tarrytown, N.Y. 10591.
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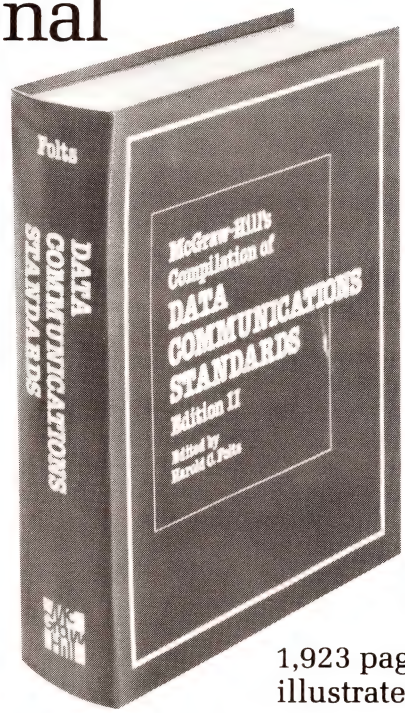
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WORK STATION ADDS MUSCLE WITH CONCURRENT PROCESSORS

Daisy's next-generation system mixes silicon compilation and custom-chip design

The push is on to get more computing performance in engineering work stations. In electronic design automation, for example, the competition is getting fierce as vendors try to provide users with the computational horsepower to do more of the arithmetic-intensive jobs—such as circuit simulation—right at the work station, thereby eliminating the need to ship jobs out to a time-shared host machine.

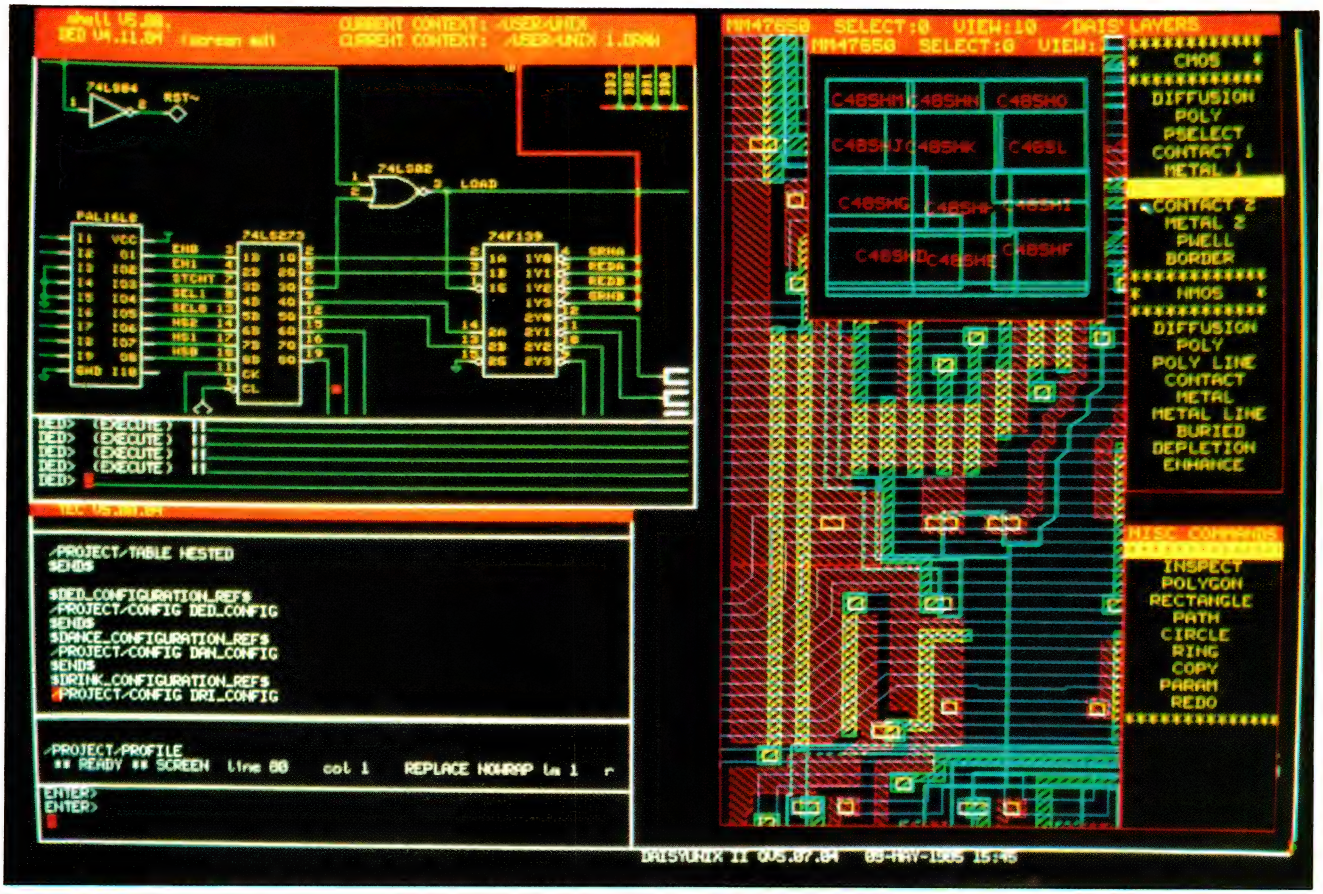
Among the products Daisy Systems Inc. is introducing this week at the Design Automation Conference in Las Vegas is a machine with concurrent processors that puts more muscle at the work-station level. The Concurrent Chipmaster is Daisy's new top-of-the-line work station and application-software package for the custom design of very large-scale-integrated circuits. In the initial hardware implementation, an Intel 80286 with a companion 80287 mathematic coprocessor teams up with another CPU, based on the National 32032 microprocessor, and a proprietary graphics processor.

"With the multiprocessor architecture and the Concurrent Chipmaster software, we can [because of the processing power and flexibility] integrate all three parts of computer-aided engineering—design, layout, and verification," says Charles Gopen, marketing manager at Daisy Systems. In the current Chipmaster work station, the company integrated engineering design-station and layout work-station functions, but users still had to go to a bigger machine for verification.

In the concurrent architecture, there is a single file system for a common design data base, a common user interface, and multiple windows and processors. What's more, each processor can run multiple processes. In this marriage of concurrent processing, windows, and multiprocessing under AT&T Bell Laboratories' Unix operating system, for example, one window can run schematic entry or editing on the 286/287 CPU while the 32032 CPU is concurrently running a circuit simulator or a silicon compiler. In addition, there may be other process windows active at the same time (as depicted in the photo below).

Each CPU can have up to 16 megabytes of memory. Plenty of disk options are available—85 megabytes of Winchester disk storage expandable up to 280 megabytes, plus an optional 475-megabyte Fujitsu Eagle Winchester disk drive. The standard software configuration includes the Daisy concurrent-Unix operating system, schematic entry tools, simulation, netlist extractors, and the MAX layout editor. Optional application packages available include the Ecad verification software, PG/E-beam fracturing software, and the DSpice circuit simulator.

According to Gopen, "the kinds and mix of jobs our customers wanted to do required more integration, interactivity, and processing power in the work station, and our answer to those



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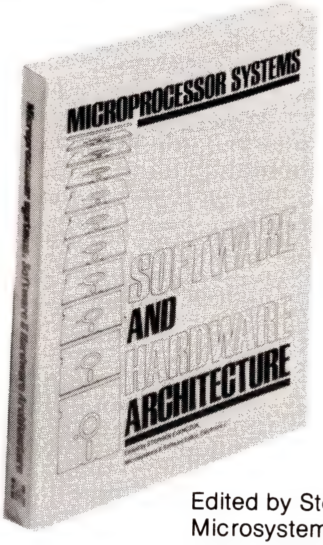

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needs was to develop the concurrent architecture. We believe it is the next-generation work station." Some of the benefits of multiple, concurrent processors are nondegraded performance for interactive editing, the ability to match different high-performance CPUs to different jobs, and, because of the faster turnaround, the tendency to do more design iterations (design, layout, and verify steps).

Silicon compilers. Two other product introductions are Boardmaster, Daisy's next-generation layout station for pc boards, and the Siliconmaster system-design work station. Siliconmaster brings together Daisy's CAE tools, including its system-level design environment and verification tools, and silicon-compiler technology from Silicon Compilers Inc. This integration of a silicon compiler for semicustom chip design and system-level design tools allows parallel development of a chip and system. Designers can easily make tradeoffs between putting functions on a semicustom chip or on the board using some other technology.

"During the system-design process, when he wants a semicustom chip, the designer goes to the silicon compiler, designs a chip and obtains the chip schematic, the timing models, and the polygons for the chip layout. Then the designer comes out of the silicon compiler and goes into the rest of the Daisy design enviornment to continue the job of system design, board layout, and verification," says Gopen.

The Daisy system also allows silicon compilation to be combined with full-custom chip design. Silicon-compiled blocks can be input as part of the custom chip design.

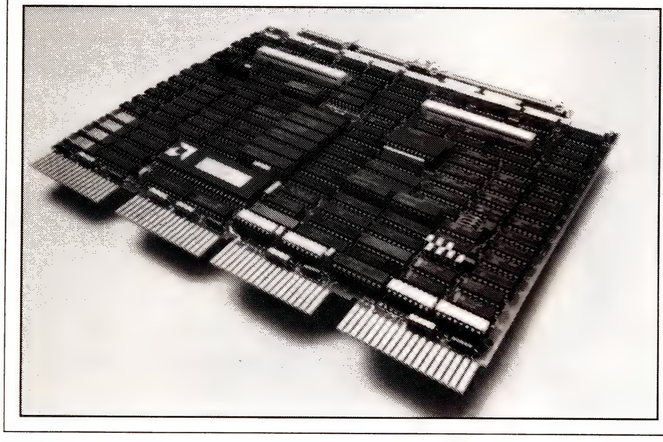
The Concurrent Chipmaster system costs $135,000 and is available now. Software options, the Dracula verification package and DSpice, sell for $65,000 amd $15,000 each, respectively. Daisy compares its package to an alternative design-automation solution consisting of a typical engineering work station, at $100,000, a Digital Equipment Corp. VAX-11/750 and peripherals ($250,000), a CAD layout station for $150,000, and verification software going for $100,000. The total cost of this alternative is $600,000. The Concurrent Chipmaster costs $135,000 plus $45,000 for verification software—a total of $180,000. *–Tom Manuel*

Daisy Systems Corp., 700 Middlefield Rd., Mountain View, Calif., 94039. Phone (415) 960-0123 [Circle reader service number 338]

Disk controllers for DEC buses transfer at 2.5 megabytes/s

Two multifunction controllers, designed for Digital Equipment Corp.'s Q-bus and Unibus-based minicomputers, support Storage Module Drive interface disks and ½-in. tape drives simultaneously.

The Spectra 25-Plus (for Q-bus) and Spectra 121-Plus (for Unibus) can handle disk transfer rates of 2.5 megabyte/s. The 25-Plus enables Q-bus systems such as LSI-11, PDP-11/23, and PDP-11/73 computers to support two physical disk drives, eight logical disk drives, and four tape drives. The 121-Plus can handle four physical disk drives, eight logical disk drives, and four tape drives for DEC's Unibus-based PDP-11 minicomputers.



List price for the Spectra 25-Plus is $3,200; the Spectra 121-Plus goes for $5,000. Quantity discounts are available for original-equipment manufacturers and distributors, and the boards are available now.

Spectra Logic Corp., 297 N. Bernardo Ave., Mountain View, Calif. 94043. Phone (415) 964-2211 [Circle 341]

Memory board for Microvax II has capacity up to 4 megabytes

One of the first add-on components for Digital Equipment Corp.'s Microvax II computer system, the CI-MIV4 memory board has a 4-megabyte capacity. Other configurations, from 1 megabyte to 4 megabytes, are also available.

Each module takes one slot in the computer's Q-bus backplane. Word size is 32 bits for the board, which consumes 1.4 A at +5 V and operates between 0°C and +70°C. The 4-megabyte board is guaranteed for five years and priced at $1,895.

Chrislin Industries Inc., Computer Products Division, 31352 Via Colinas, No. 101, Westlake Village, Calif. 91362.
Phone (818) 991-2254. [Circle 342]

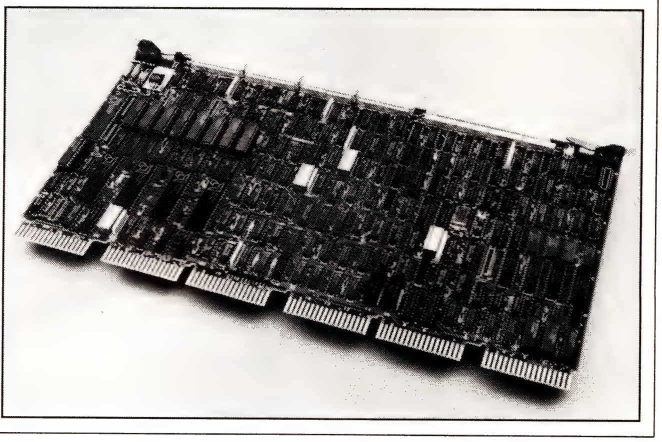
Disk controllers support four physical disk drives

Two hex-size controllers will operate disk drives with a Storage Module Drive interface that supports both the standard data rate of 1.2 megabytes/s and faster rates up to 1.8 megabytes/s.

The DK11-RM and DK11-RP Storage Module Drive disk controllers for Digital Equipment Corp.'s Unibus and VAX systems can support four physical drives. In a two-drive system, two logical units per drive can be supported, for a total of four logical units. The two physical drives can have different capacities and/or emulations.

The DK11-RM, which can emulate RM80, RM02, and RM05 drives, and the DK11-RP, which emulates RP06 drives, are transparent to most DEC operating-system software. An onboard disk-address translator permits different disk drives of different configurations to be attached to the controller without necessitating software or firmware changes on the controller board.

An optional extended direct-disk-mapping mode allows users to implement gigabyte-sized storage capacities, and an onboard, three-sector, 1,536-byte buffer provides data smoothing and helps eliminate disk data late errors. Both controller



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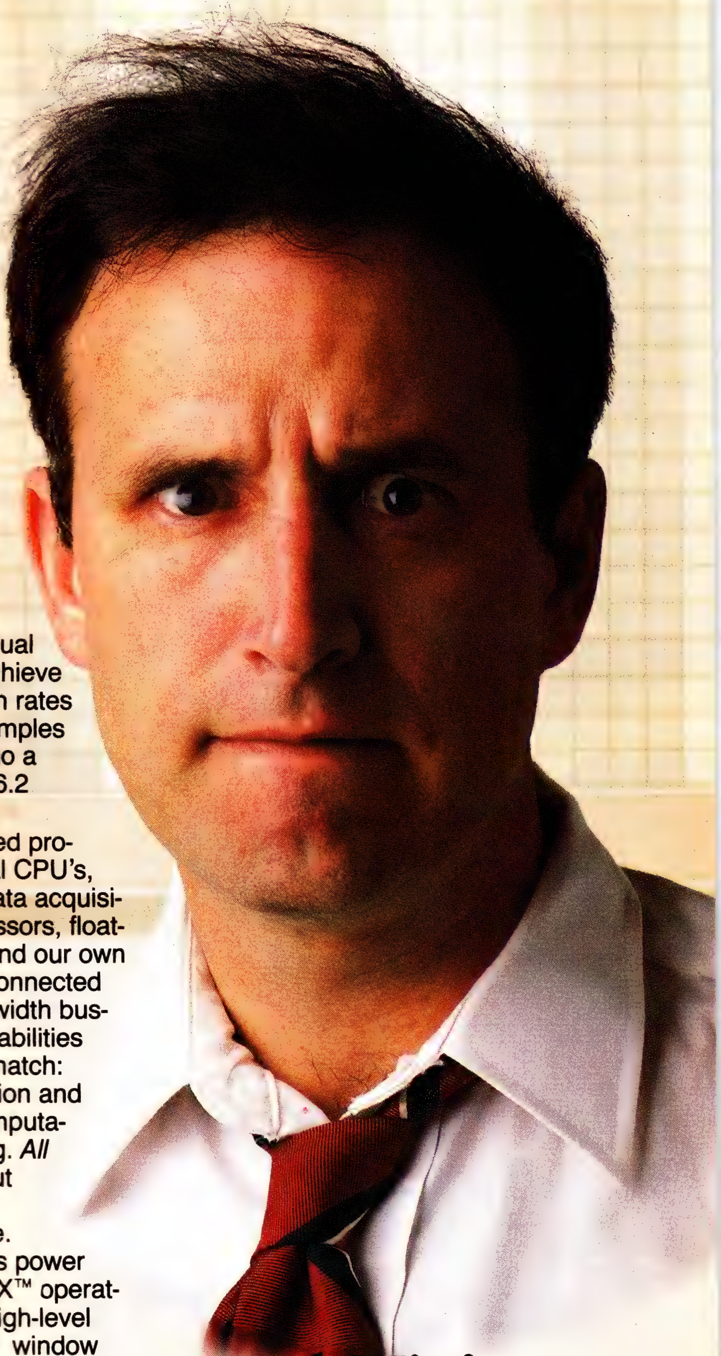

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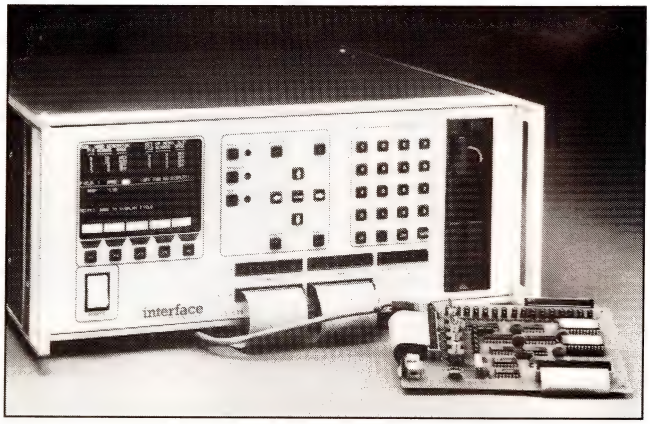
boards are priced at $3,900 each, and discounts are available for original-equipment manufacturers. Delivery takes two weeks.

MDB Systems Inc., 1995 N. Batavia St., Box 5508, Orange, Calif. 92267. Phone (714) 998-6900 [Circle 343]

Digital word generator has built-in disk drive

The RS-670 digital word generator/timing simulator formats and sequences data to maximize available memory, thus permitting the generation of both periodic and variable pulse width to create complex digital waveforms.

The instrument also has an on-board floppy disk to store frequently used test routines. Programs can be written either on the RS-670 or on an IBM Corp. Personal Computer, then stored on disk and downloaded when needed for remote programming. Any type of computer can serve as a controller. This saves engineering time that might otherwise be wasted if data had to be re-entered by hand. It also allows the unit to be used with a logic simulator or test-program generator to verify computer-aided-engineering hardware.

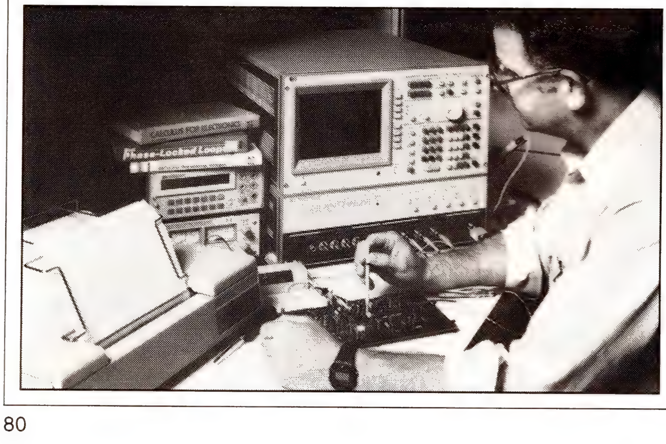


The word generator can operate in both parallel and serial modes, and channel-to-channel and clock-to-clock three-state control is included so the user can perform complex tests such as those needed for ICs. Depending on the configuration, the RS-670 ranges in price from $10,500 to $14,000. Delivery takes 8 to 10 weeks.

Interface Technology, 150 E. Arrow Hwy., San Dimas, Calif. 91773. Phone (714) 592-2971 [Circle 344]

Impedance/gain-phase analyzer controls its own activities

The HP4194A analyzer measures impedance from 100 Hz to 40 MHz and gain phase from 10 Hz to 100 MHz. The instrument includes a 7½-in. color CRT display and can be used to evaluate materials, components, and ICs. Two measurements can be displayed on the screen simultaneously and analyzed using a graphics analysis function.



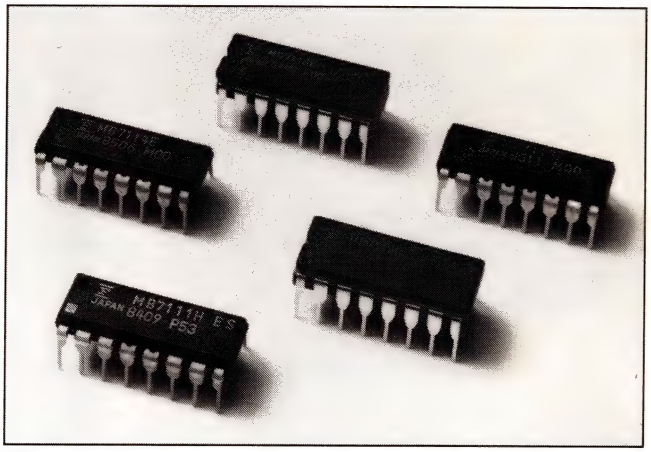
The analyzer's Auto-Sequence Program—an internal programming language that controls its operations—automates measurement and analysis functions without a separate computer. The analyzer also features menus and soft keys for easier use.

The HP4194A is priced at $19,800. An optional high-stability frequency-reference oscillator, which the company says is necessary to detect the resonant frequency of high-Q devices such as crystals, costs $800. Shipments will begin next month, and delivery will take about four weeks.

Hewlett-Packard Co., Inquiries Manager, 1820 Embarcadero Rd., Palo Alto, Calif. 94303 [Circle 345]

PROM needs just 100 mA and features 15 ns access

Three PROMs offer typical access times between 15 ns and 20 ns, and they consume only 100 mA. The 2-K MB7115/7116, the 1-K MB7113/7114, and the 256-bit MB7111/7112 are organized as 512 by 4 bits, 256 by 4 bits, and 32 by 8 bits, respectively.



The chips incorporate Deap (Diffused Eutectic Aluminum Process), a programming mechanism in which fuses run vertically through more than one layer of the semiconductor. Thanks to Deap, the memories offer higher reliability and higher programming yields than their conventional counterparts, claims the manufacturer. In addition, the chip's vertical structure yields smaller die sizes, which decreases access times.

In quantities of 1,000, the 2-K chip (20-ns access time) is priced at $1.71, the 1-K version (20-ns access time) at $1.44, and the 256-bit memory (15-ns access time) at 96¢.

Fujitsu Microelectronics Inc., Marketing Communications, 3320 Scott Blvd., Santa Clara, Calif. 95054.
Phone (408) 727-1700 [Circle 346]

High-density 64-K SRAMs offer speed-power tradeoffs

Fabricated in high-density HCMOS III (Motorola's proprietary CMOS process), the MCM6164 64-K-byte SRAM uses 1.5-μm rules to maximize speed and minimize power consumption, the company says.

The three versions of the chip offer a variety of speed and power-consumption characteristics. The MCM6164-45 has a typical access time of 45 ns and burns 80 mA maximum. The 6164-55 has a 55-ns access time and requires 70 mA maximum current. The 70-ns 6164-70 needs 60 mA. The memories have

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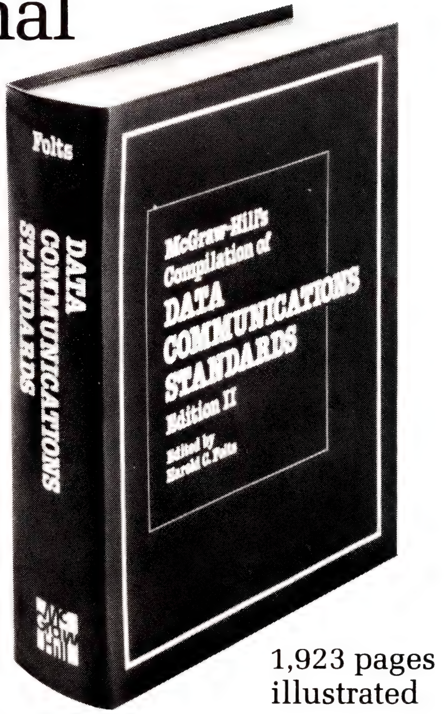
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improved address-transition detection circuitry that is said to be impervious to address skew. Operating from a +5-V supply, they need 5 mA standby current at TTL levels and 2 mA at CMOS rail-input levels.

The chips are housed in 600-mil 28-pin plastic DIPs. Samples will be available in July. In 100-unit quantities, the 70-ns chips cost $30 apiece, the 55-ns chips $35, and the 45-ns chips $50.

Motorola Inc., Memory Products Division, 3501 Ed Bluestein Blvd., Austin, Texas 78721. Phone (512) 928-7505 [Circle 347]

Static ROM's power-down feature saves up to 80%

The SM23512 512-K static ROM features a 150-ns access time and uses 70 mA of current when active, 20 mA standby. It is compatible with most microprocessor families, the manufacturer claims.

Built in high-performance MOS technology, the chip is organized as 64-K by 8 bits and packaged in a standard 28-pin ceramic or plastic DIP. With automatic power-down, the part can provide a system-level power saving of up to 80%, says the company.

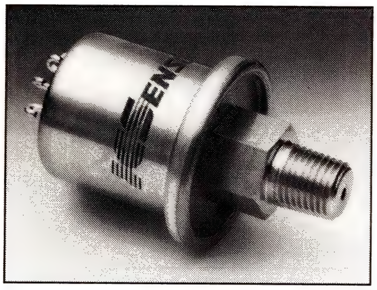
The chip features a pair of mask-programmable pins for chip select controls and uses a 4.5-μm^2 X-cell matrix—the smallest in the industry, says the company. Available immediately, the SM23512 is priced at $17 in quantities of 1,000.

Silicon Macrosystems Inc., 2960 N. 1st St., San Jose, Calif. 95134. Phone (408) 434-1100 [Circle 348]

Pressure sensors are accurate to better than ±0.25%

Two pressure sensors for water-management, environmental-control, and refrigeration applications can monitor pressures to 5,000 lb/in^2. Output spans are typically 100 mV.

The model 103, a piezoresistive pressure sensor, is housed in a cylindrical casing with a stainless-steel fitting. The solid-state device is media compatible with corrosive and conductive fluids and with gaseous media. It is accurate to ±0.25% and available in a variety of pressure ranges.



The model 113, an isopressure solid-state sensor, is also housed in a cylindrical casing with an identical fitting. Accurate to ±0.5%, the unit uses an oil column to couple a diffused, piezoresistive sensor to a stainless-steel diaphragm that can be interfaced with most harsh media.

In quantities of 100, the 103 is priced at $85 and the 113 at $95. Delivery takes between four and six weeks.

IC Sensors, 430 Persian Dr., Sunnyvale, Calif. 94086. Phone (408) 745-1814 [Circle 349]

Analog pressure sensors are laser-trimmed for accuracy

The PV series of solid-state pressure sensors is designed for applications that require continuous measurement of pressure rather than detection of a momentary output. The sensors provide pressure-to-current analog output for precise monitoring in the gauge-pressure ranges of 3 to 15 lb/in.^{2}, 0 to 100 lb/in.^{2}, and 0 to 250 lb/in.^{2}

The sensors are built into zinc die-cast housings with Buna-N sealings. They can be used with the manufacturer's SID-2000 sensor interface device, using the analog sensor input module to provide high linearity. The benefits of the hybrid device include computer-controlled laser trimming to provide close control of important sensor parameters, according to the company. Temperature-compensation circuitry is also included.

The sensors are available two to four weeks after ordering. In quantities of 100, they sell for $135 each.

Honeywell Inc., Micro Switch Division, 11 W. Spring St., Freeport, Ill. 61032. Phone (815) 235-5731 [Circle 350]

Tektronix enters CAE market with IBM PC AT-based unit

Through its CAE Systems Division, which is an authorized IBM Corp. value-added reseller, Tektronix has entered the market for microcomputer-based computer-aided-engineering work stations. Using an IBM Personal Computer AT as a building block, Tekstation AT also incorporates a Digital Equipment Corp. VAX-11/750-class, 32-bit, 10-MHz coprocessor and a graphics card providing 720-by-704-pixel resolution. Disk storage in the basic AT has been increased to a minimum of 85 megabytes, expandable to 280 megabytes, while RAM has gone to 2.5 megabytes, expandable to 4.5 megabytes in standard configurations.

In software, the Tekstation AT incorporates software-development tools, 16 megabytes of virtual memory, and a distributed file system through the manufacturer's proprietary operating system, Utek, an enhanced version of Berkeley 4.2 Unix.

With CAE 2000 designers' data-base and schematic-capture software, Utek is the environment for design capture, design verification, and physical layout. Utek also supports Ideal logic-simulator software. Tekstation AT can be connected through an Ethernet interface priced at $1,400, and a file-server configuration is available for about $40,000. Pricing starts at $25,000, with deliveries begining in July.

Tektronix Inc., CAE Systems Division, 1333 Bordeaux Dr., Sunnyvale, Calif. 94089. Phone (408) 745-1440 [Circle 356]

CAD system is reconfigurable without changing hardware

Euclid, an integrated computer-aided design and manufacturing software system based on three-dimensional modeling techniques, is the cornerstone of the Series 50 work stations, which also offer dynamic reconfiguration. This capability allows the designer to choose and interactively combine antialiasing, windowing, number of colors, shaded images, and Euclid Turbo, which gives high-speed response to commands. With no change in hardware, the Model 53 work station can be dynamically configured in many combinations—for example, with 128 colors and antialiasing or with four colors with windowing, antialiasing, and other configurations.

From 4 to 24 memory planes are available in the graphics mode, with cache for each memory plane. Direct memory access permits characters to be displayed in 220 µs. In vector mode, the Series 50 work stations perform at 300 ns/pixel. Resolution is 1,280 by 1,024 pixels on a 19-in. screen.

A 32-bit main processor—the Motorola 68000—and 1 megabyte of main memory control the peripherals, which include the screen, keyboard, graphic controller, stylus or puck, and a tablet with an 11-by-11-in. addressable surface. The price of the Series 50 work station is $40,000, and shipments are being made from stock.

Matra Datavision, 99 S. Bedford St., Corporate Place 1, Burlington, Mass. 01803.
Phone (617) 229-2630 [Circle 357]

Dual-mode tape drive offers choice of recording densities

Data recording at any one of three densities—800, 1,600, or 3,200 bits/in.—in both a true start-stop mode (45 in./s) with no repositioning between records or streaming mode (100 in./s) is possible with the model 9600A ½-in. streaming tape drive.

Other features are horizontal mount with tape insertion from the front, autothreading, and auto-loading. Users can read built-in diagnostics from an eight-digit front-panel display.

The model 9600A incorporates capstan and tension arms for precise, fast tape positioning. The drive, which offers a mean time before failure of 5,000 h, is easy to maintain and service, the company says. In single-unit quantities, its price is $5,400, with quantity discounts offered. Units are available now.

Kennedy Co., 1600 Shamrock Ave., Monrovia, Calif. 91016.
Phone (818) 357-8831 [Circle 360]

Optical disk drive stores 400 megabytes on 5¼-in. disk

A laser-based, thin-film storage medium, the model 5984 optical disk drive offers 400 megabytes of write-once-read-mostly (WORM) data-storage space on a 5¼-in. disk. Optotech Inc., its manufacturer, says it is the most storage offered on any optical system and five times the capacity of equivalently priced

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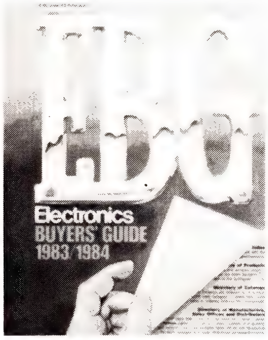

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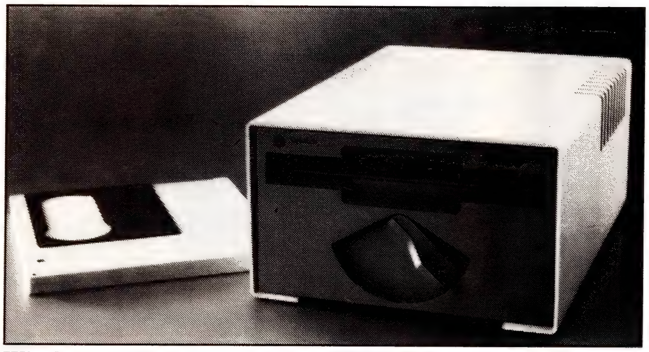


Winchester hard disks. The optical disk drive's read-write head cannot crash and damage the surface of the medium, and because it is 1 to 2 mm above the surface, wear is not a problem.

The projected life of an optical disk is up to 10 years, making it suitable for data that must be archived for long periods, such as medical and dental records and legal files, the company says. To ease integration of the model 5984 as a component of office work stations, the manufacturer is offering customers a development system for creating hardware and software interfaces. A controller and software for the IBM Corp. Personal Computer also are available, and a host adapter for the SCSI standard is under development.

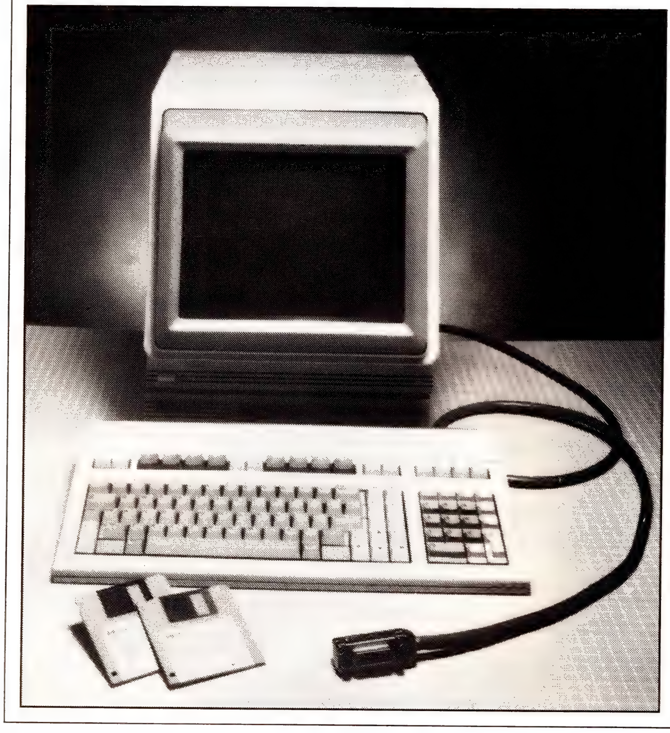
Evaluation kits, at $5,000, are available now. When production begins, volume orders will be priced at $2,500 per unit for less than 1,000 units, $1,000 for orders of over 1,000.

Optotech Inc., 770 Wooten Rd., Suite 109, Colorado Springs, Colo. 80915. Phone (303) 570-7500 [Circle 359]

HP's Touchscreen computers take on engineering tasks

The Touchscreen computer from Hewlett-Packard Co., aimed at business applications, is now moving into the engineer's workplace. With the Touchscreen HP-IB controller and the Touchscreen PC-IB, the user can perform test-and-measurement procedures and run MS-DOS business software.

Able to control up to 14 HP-IB devices, the Touchscreen HP-IB controller consists of a Touchscreen II base system (256-K bytes of RAM expandable to 640-K bytes, and 160-K bytes of ROM), the Hewlett-Packard Interface Bus Command library, and the HP Touch accessory. The accessory is a bezel, 3 in. deep, that fits onto the screen and contains the electronics for the touch feature; when the user's finger intercepts the grid on the Touch accessory, the interruption registers and is transmitted as a system command.



The Touchscreen PC-IB controller consists of a Touchscreen II base system (with a 384-K byte RAM board added for a total of 640 megabytes of RAM), the HP Touch accessory, a PC Instruments interface, and GW Basic. Users create an automated-instrument system by adding their selection of up to eight modular PC Instruments per interface card to the controller.

Both controllers have four I/O slots for expanding memory and adding accessory cards, and three standard ports: one HPIB port, one RS-232-C port, and one for either an RS-232-C or an RS-422 interface standard. All ports operate at baud rates up to 19.2 Kb.

The Touchscreen personal computers incorporate an Intel 16-bit 8088 microprocessor, with an 8087 math coprocessor to be added this summer. Users can choose from floppy-disk drives with total capacity of 710-K bytes or Winchesters with 10 or 20 megabytes of storage. Peripherals can be controlled from the 12-in. display screen by means of the Easy Config program utility, and eight on-screen "softkeys" display commands.

The Touchscreen HP-IB controller is priced at $3,430; a complete system, with mass storage and GW Basic or Pascal, starts at $4,495. The PC Instruments interface (including accessory card and software) is $500, and the instruments themselves (50-MHz oscilloscope, 4½-digit multimeter, and others) range in price from $650 to $1,500.

The Touchscreen PC-IB controller is $4,935, and the HP-IB Command library can be added for $300. The Touch accessory bezel is also available as an option for $300. Systems are available this month through the manufacturer's sales offices.

Hewlett-Packard Co., Inquiries Manager, 1020 N.E. Circle Blvd., Corvallis, Ore. 97330 [Circle 363]

Q-bus system gives choice of CPUs and storage devices

Flexibility in choice of storage media and a variety of CPUs mark the VQ-11/model 600 series systems, which are based on the Q-bus. The computers are aimed at the multiuser environment and provide Winchester, floppy-disk, and cartridge-tape storage in a single package measuring 5¼ by 19 by 25½ in.

In the model 600 series, the Winchesters have formatted capacities from 30 to 160 megabytes, with access time as fast as 18 ms. Both the ST506 and the Storage Module Drive interfaces are supported.

Continuing the multiuser emphasis, the manufacturer puts CPUs into the model 600 series that, in the case of the LSI-11/73, support up to 30 users; the LSI-11/23 and Microvax CPU are also available. System memory capacities range up to 4 megabytes, and the systems have from 4 to 36 serial channels.

Operating systems supported by the VQ-11/model 600 series include RSX-11M and RSX-11M+, the Ultrix version of Unix, a medical package called Mumps, RSTS, TSX+, and Share-11. Systems can be purchased with or without bundled software; local-area-network interfaces, including an interface for Ethernet, are available as options.

A sample package, the model 602, offers 160 megabytes of Winchester storage, an 8-in. floppy disk, and a 60-megabyte, 90-in./s streaming cartridge drive; the LSI-11/73 CPU; 12 serial channels; 2 megabytes of block-mode main memory; and four quad-width plus one dual-width Q-bus expansion slots.

The single-unit price of this package is $20,500, and discounts are offered for volume orders. Delivery is from stock to 30 days.

Zoltech Corp., 7023 Valjean Ave., Van Nuys, Calif. 91406.
Phone (818) 780-1800 [Circle 361]

Modeling system sets up manufacturing schedules

Malta software takes an unusual approach to equipment-capacity planning and labor loading: it does not require that shop routing structures be loaded for every part to be manufactured, and it does not need other manufacturing systems.

The software is menu-driven from the screen. It comes with a model and a specimen program that walks the user through the various analysis levels.

Malta analyzes manufacturing operations, equipment cost, and equipment-capacity utilization, among other factors. It takes into account labor requirements and standards. What's more, it deals with two sensitive predictions—planned inventory levels and planned cycle times—as well as optimum use of materials and space. Finally, the program delivers the cost of total manufacturing and the cost per unit of product.

Priced at $995, Malta runs on the IBM Corp. Personal Computer, PC/XT, and PC AT. It requires 128-K bytes of main memory, two disk drives, and DOS 2.0 or higher operating system. Malta is available now.

Manufacturing Strategies Inc., 1208 Apollo Way, Suite 502, Sunnyvale, Calif. 94086.
Phone (408) 735-0900 [Circle 365]

Software package bridges design and test phases

Testools integrates the design and testing of large-scale and very large-scale ICs. This software package, which links design and test engineers to their respective systems, consists of three programs: Pattern Bridge, Advanced Pattern Tool, and Emulator Modeling Utility. In a design-and-test workplace with many kinds of equipment—computer-aided-engineering work stations, logic analyzers, and VLSI testers—from more than one manufacturer, the three-part software provides communication among engineers and machines.

Pattern Bridge enables the test engineer to use the circuit designer's simulation results on the test system and gives the designer test patterns, compatible with the target system, that are gener-

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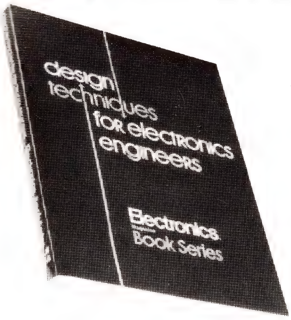

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ated by the test engineer. Advanced Pattern Tool lets the design engineer build a test pattern for testing a simulated design; the test engineer can then take over and enhance the design engineer's results to complete the process.

For the test engineer who does not have access to a design simulator, the Emulator Modeling Utility simulates the behavior of LSI and VLSI devices. It combines an intelligent pattern editor, a logic emulator, and a symbolic assembler.

The Testools family is available for VMS, Aegis, RSX-11M, and AT&T Bell Laboratories Unix operating systems. Testools products are available in configurations for popular design systems, simulators, and LSI/VLSI testers.

The price of Pattern Bridge for a Digital Equipment Corp. VAX is $12,000; for other work stations, it costs $6,000. Advanced Pattern Tool is priced at $10,000 for a VAX and $5,000 for other systems. The Emulator Modeling Utility is priced at $12,000. Delivery in each case takes 30 to 90 days, depending on system configuration.

Test Systems Strategies Inc., 7929 S.W. Cirrus Dr., Beaverton, Ore. 97005. Phone (503) 643-9281 [Circle 364]

Wafer-repair system removes defects with metal-ion beam

Using a liquid metal-ion source and precise electrostatic optics to create beam diameters of about 0.2 μm, the 808 system repairs mask and reticle defects. The finely focused beam removes chrome defects of 0.3 μm on photomasks or reticles with geometries that are less than 1 μm.

Repair of clear defects and removal of chrome defects are done with a single insertion and set-up, the manufacturer says, and defects are located and repaired as they are identified by any automatic inspection system. The menu-driven system includes mouse-controlled software that allows zoom, pan, and verification of defects prior to repair. Typical load-to-unload times are under 15 min. Pricing information is available on request.

KLA Instruments Corp., Rapid Division, P.O. Box 58016, Santa Clara, Calif. 95052. Phone (408) 988-6100 [Circle 351]

Digital microscopy system permits submicron analysis

Measurement and analysis can be performed on semiconductors in the submicron region with the Accuvision digital microscopy system.

The Accuvision system comes with a software library and a linewidth measurement package that permits measurement and visualization of chip features as small as 0.2 μm. The system uses real-time digital processing techniques to provide nondestructive, rapid analysis of the topologies and structures of a semiconductor.

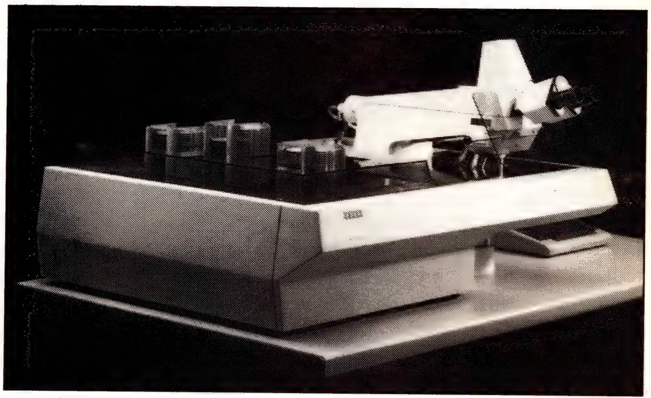
Magnification of 10,000× to 20,000× is supported by this digital processing technique, and software algorithms are menu driven to increase throughput and simplify operation.

Priced at $78,000, the system is available now. Delivery takes 30 days from receipt of order.

IVS, 45 Winthrop St., Concord, Mass. 01742.
Phone (617) 371-2600 [Circle 352]

Automated inspection system tansports wafers in a vacuum

Integrated circuits can be inspected on the fabrication line quickly and easily with the 6-in. Zeiss Wafer Inspection System, the manufacturer says, adding that physical damage and wafer contamination are minimized, thanks to automatic wafer handling and vacuum transportation of wafers between carrying cassettes and the microscope. The inspection system features a motorized objective turret, fiber-optic illumination to prevent heat contamination of the wafers, and automatic focusing.



A tiltable binocular tube produces an upright and unreversed image. All controls are placed ergonomically to ensure fatigue-free operation even over long periods. Three versions of the objective lens are available: bright field, bright field/dark field, and bright field/dark field/differential interference contrast. Pricing and availability information was not available at press time.

Carl Zeiss Inc., Thornwood, N.Y. 10594.
Phone (914) 747-1800 [Circle 353]

Expanded display system family targets specific applications

Expanding its 3000 line of color raster display systems, Adage Inc. is introducing a trio of new configurations that is aimed at specific markets. The 3110, which is intended for advanced computer-aided design and seismic applications, uses a 32-bit graphics processor that produces a 1,024-by-1,024 pixel image with 16 bits per pixel; it displays more than 65,000 colors. The 3110 is expandable to a double-buffered 1,024-by-1,024-by-24 image memory and 3 megabytes of list memory.

Tailored for advanced imaging and graphics, the 3130 system includes a local graphics processor, 1 megabyte of display list memory, and quad-buffered 1,024-by-1,024-by-8-bit image memory. The image memory is software-reconfigurable for 512-by-512-pixel full-color display with 256 overlay colors. Real-time video input is available as an option.

The 3140 system is a multiprocessor arrangement designed for real-time simulator displays. It combines local graphics and transformation processors with an advanced graphics generator, and, when used with the manufacturer's IDL2 software, provides real-time display updates in response to changes in the simulator model.

The 3110, 3130, and 3140 run on Digital Equipment Corp.'s

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The Market
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Target Readers
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Electronics
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Electronics
July 22 issue

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Applications-Specific ICs

Individually designed chips promise to affect every level of the product creation process—from parts purchasing to marketing and sales. This ElectronicsWeek report zeroes in on new technologies and configuration trends, and projects the prospects for techniques still on the drawing board.

The Market
An estimated 50% of the $70 billion total IC market by 1990.

Target Readers
Device designers, systems makers, product planners, and virtually all management in electronics.

Issue Date:
July 22, 1985

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Electronics
Influence Beyond Design

PDP-11 and VAX/11 computers. The 3110 and 3130 systems—including hardware, the FSS 3000 Fortran subroutine package, and either Seismic 3000 or Solid 3000 software—are priced starting at $49,400. The 3140 system—including hardware and IDL2 software—is priced starting at $58,200. The price of the standard 3010 system is $38,300.

Adage Inc., 1 Fortune Dr., Billerica, Mass. 01821.
Phone (617) 667-7070 [Circle 366]

Monochrome terminal offers high resolution at 380 ns

Screen resolution of 2,048 by 1,568 viewable points plus the benefits of raster display is what differentiates the model 3219W monochrome terminal. A speed of up to 380 ns per pixel is possible in the vector mode. An optional second memory plane provides antialiasing; without this line-smoothing capability, the normal pixel writing speed is 2,200 ns per pixel. The refresh rate is 57 Hz (noninterlaced) on a 19-in. green fast-phosphor (P31) screen that incorporates an antireflective bonded faceplate.

The model 3219W is software-compatible with the Tektronix 4014 terminal; further, it lets the user choose among 16 graph makers. When the basic configuration is upgraded by adding the optional Graphics Manager boards, the 3219W can pan, zoom, rotate, and deliver two-dimensional and 3-d images.

The price of the model 3219W monochrome terminal is $14,950 for one unit. The manufacturer will quote volume-order discounts and shipping schedules.

Westward Technology Inc., 90 Montvale Ave., Stoneham, Mass. 02180. Phone (617) 438-6623 [Circle 367]

Radiation-resistant camera has 1,000-line resolution

Designed to withstand a total gamma-radiation dose of 10^8 roentgens, the model ST-5/HB radiation-resistant camera system features 1,000-line resolution and remote optical focus.

The system consists of a cylindrical camera head, a 300-ft control cable, and a self-contained camera-control unit. By using an optional signal amplifier, the cable length can be increased to 700 ft. The camera head is water- and dust-tight and is constructed of epoxy-painted aluminum to ease the decontamination process.

Available with either a videcon or heterojunction pick-up device, the camera can be ordered with optional nonbrowning optics and both fixed and zoom lenses. A typical system, which can be delivered about four weeks after receipt of order, is priced at about $6,100.

Arvin Diamond Inc., P.O. Box 200, Lancaster, Ohio 43130.
Phone (614) 756-9222 [Circle 354]

Resistor-capacitor nets bow for ECL, Thevenin termination

The MDRC series of molded DIP resistor-capacitor networks offers three models that are suitable for automatic insertion. For a 2.0-V ECL termination, the MDRC-1641 contains 11 resistors of equal value and a 0.01-μF decoupling capacitor for bypassing transients between supply voltages. For ECL pull-down to a 5.2-V bus, the MDRC-1642 contains 12 resistors and a 0.01-μF capacitor for bypassing transients on the voltage bus.

The MDRC-1643 contains four series pairs of resistors, and it targets Thevenin-equivalent termination. A divider between the pairs provides a Thevenin-equivalent voltage of 2.0 V and a 0.01-μF decoupling capacitor that bypasses the VEE bus.

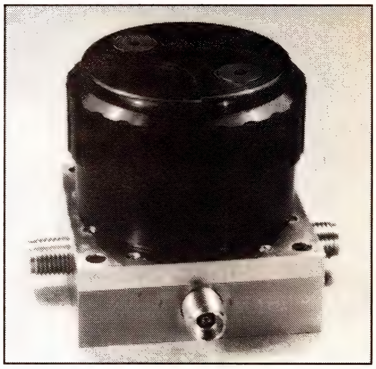
The operating-temperature range of the networks is –30°C to +85°C, with ratings determined at 25°C. The power rating of each model is 2.0 W maximum, with individual resistors rated at either 0.15 W or 0.20 W, depending on the model. Capacitor voltage rating is 25 V maximum.

A typical model, the MDRC-1641, is priced at 72¢ in quantities of 1,000. Delivery takes about 12 weeks.

Dale Electronics Inc., P.O. Box 26728, El Paso, Texas 79926.
Phone (915) 592-3253 [Circle 373]

Coplanar switch performs at 26.5 GHz and higher

A four-port switch for microwave-system designers operates from 26.5 to 40 GHz. Called a "coplanar" switch—the technology is planar and the transitions are coaxial Wiltron K-Connector—the switch's electrical isolation is specified at lower than 50 dB even at the highest frequencies.



For simplicity, the switching-drive mechanism is manual. It has a positive detent for repeatable positioning. Insertion loss emulates a predictable lossy 50-transmission line with a nominal 0.05 dB/GHz.

The switch is intended for such applications as signal steering in coaxial-based equipment and instrumentation to the upper edge of the microwave-frequency bandwidth. The switch (model number 812-0007-00) will be available for delivery in August, according to the manufacturer. In quantities of 1,000, it will sell for $775.

Tektronix Inc., Attn: Field Office 12, M/S 58-147, P.O. Box 500, Beaverton, Ore. 97077. Phone (503) 627-1299 [Circle 370]

Device-modeling capability is added to Genrad's Hilo

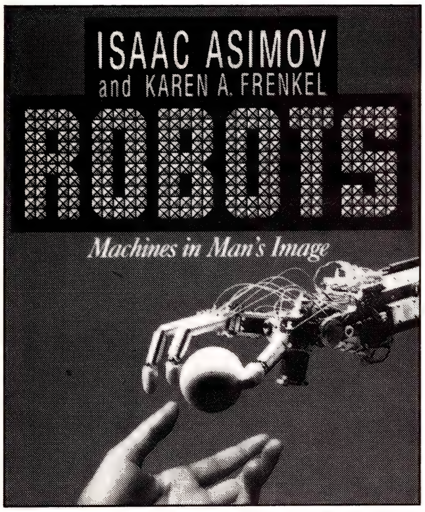
A physical-hardware modeling system that allows design engineers to incorporate complex very large-scale-integration parts into Hilo logic simulation is Genrad's attempt to bridge the gap between computer-aided design and automated test. Hichip reduces the need to write lengthy and complex software models for complex chips, saving valuable engineering time and effort, the company says.

The Hichip captures a VLSI component in a model library by physically connecting the device to a personality board and describing the external pin connections and associated delay parameters. The minimum configuration includes a Motorola Inc. 68000 processor with 64-K by 128 bits of pattern memory for test-vector storage, and a single personality card containing up to two 64-pin devices; a 16-MHz internal clock is also included to allow 16-MHz vector-input pattern speeds, which support design configurations using advanced microprocessors such as the 68020.

The Hichip is designed to run on the same systems that run the Hilo logic-simulation software package. Connection to a computer system is by way of an RS-232-C serial interface port; and for operation in a networked environment, for hardware libraries requiring more than 16 devices, an Ethernet port is available.

Initial deliveries of the Hichip are scheduled for November of this year. Prices for the system start at $36,000.

Genrad Inc., 300 Baker Ave., Concord, Mass. 01742.
Phone (617) 890-4900 [Circle 378]



America's foremost champion of robots, Isaac Asimov, has collaborated with science writer Karen Frenkel on *Robots: Machines in Man's Image,* an overview of state-of-the-art robotics. Foundry and assembly-line robots as well as scientific robots such as a remotely controlled diving machine occupy most of the text. But the authors do not overlook toys and oddities such as the Marilyn Monroe look-alike—with 20,000 electronic components—that sang and played the guitar at the 1982 Osaka Jewel Fair. One chapter deals with robots in the world economy—who uses robots and why, and their effect on the job market. Research and development in medicine, agriculture, artificial intelligence, and improved means of locomotion are discussed—even robots in the movies. Manufacturers and trade associations are listed at the back of the book, which is illustrated in black and white and in color. The 246-page large-format volume, priced at $19.95, is published by Harmony Books, 1 Park Ave., New York, N.Y. 10016. Phone (212) 532-9200 [Circle reader service number 471]

An overview of dot-matrix printers—Epson, Okidata, Gemini, Prowriter, NEC 8023A, and the Apple Imagewriter—for the end user is presented in *Minute Manual for the Dot Matrix Printer.* Speed and price are discussed, and the mechanics of a dot-matrix printer are described, with an emphasis on the interface between printer and computer, and rating software in terms of its printer-control capabilities. Available from Minuteware, P.O. Box 2392, Columbia, Md. 21045, the 166-page paperback is priced at $12.95.
Phone (301) 995-1166 [Circle 472]

Reliability and applicability of commercial-grade ICs, especially plastic-encapsulated ICs, are discussed in *Soar-3: IC Quality Grades, Impact on System Reliability and Life Cycle Cost* from Reliability Analysis Center. This 100-page report compares initial cost and procurement lead time; examines the effects of various application stresses on plastic commercial ICs; and presents a life-cycle cost analysis for the alternative-part quality grades. A statistical model for IC component cost is also presented. The third volume in the State of the Art Report series, the publication costs $46 and should be ordered prepaid with checks made payable to IITRI/RAC. The address is Reliability Analysis Center, RADC/RAC, Griffiss AFB, N.Y. 13441.
Phone (315) 330-4151 [Circle 473]

An annual update, *1985 Semi Standards* has been published in five volumes: chemicals, equipment, materials, packaging, and photomasks. The books provide complete listings of recently approved standards, updating of existing standards, and proposed standards now in committee. The materials volume also includes test methods from the American Society for Testing and Materials (ASTM). Called essential to standardizing manufacturing operations and reducing costs, the complete set is priced at $150 (mail orders add $5 for shipping; California orders add sales tax). Volumes may also be purchased separately. Orders go to Semi Standards, Dept. 05607, San Francisco, Calif. 94139. For further information, call the Semiconductor Equipment and Materials Institute Inc. at (415) 964-5111. [Circle 474]

To locate vendors of engineering software, the frustrated customer could try the 1985 edition of *Engineering/Softwhere,* which categorizes programs in 17 areas—aerospace, chemical, design and analysis, modeling and simulation, data-base management, and more—over 1,500 program listings from several hundred vendors. The catalog is priced at $49.95, and it is available from Moore Data Management Services, 1660 S. Highway 100, Minneapolis, Minn. 55416.
Phone (612) 530-1022 [Circle 478]

Based on information compiled by DM Data, which also publishes the newsletter "AI Trends," a directory of more than 200 companies concerned with artificial intelligence, expert systems, AI programming languages, natural language, symbolic computing, voice recognition, artificial-vision systems, and related areas will be published this summer. Softbound, *The Artificial Intelligence Directory, 1985 Edition* will identify each company and its contact persons, and give product and sales information. Orders for the $39.95 directory should be sent to DM Data Inc., 6900 E. Camelback Rd., Suite 1000, Scottsdale, Ariz. 85251.
Phone (602) 945-9620 [Circle 475]

Computer-graphics vendors, 550 of them, are listed in the 1985 edition of *The S. Klein Directory of Computer Graphics Suppliers.* Company data include product line, ownership and contact person, and sales volume. Further, the directory has added a section on consultants, plus educational and training resources. Through July 1, the 204-page directory will sell for $57; thereafter, $65. Make checks payable to S. Klein Directory, c/o Technology & Business Communications Inc., 730 Boston Post Rd., P.O. Box 915, Sudbury, Mass. 01776. Phone (617) 443-4671 [Circle 476]

More than 18,000 installations of Autocad computer-aided-design software will benefit from the publication of *Inside AutoCAD,* a 252-page handbook for users of this program. Ten chapters cover topics that range from configuring Autocad and becoming familiar with the program to customizing the software to fit a particular CAD environment. Each chapter contains a tutorial. Priced at $27.95, the book is published by New Riders Publishing, P.O. Box 4846-A, Thousand Oaks, Calif. 91360.
Phone (818) 991-5392 [Circle 477]

Job-hunting is a fact of life that *High-Tech Job Finder: A Guide to America's 100 Hottest Communities* can make more palatable to the professional who is trying to sort out the next career move. From San Diego's "Silicon Harbor" to Washington's "Satellite Alley," the authors detail the types of jobs available in each area and tell something about the surrounding communities, their attractions and drawbacks. Other chapters help the job-changer analyze his or her own desires and requirements. Nearly 1,500 employers of high-tech personnel are listed. This $9.95 paperback should be ordered from John Wiley & Sons, 605 Third Ave., New York, N.Y. 10158.
Phone (212) 850-6497 [Circle 479]

Proceedings of the International Symposium on Methods and Materials in Microelectronic Technology, edited by Joachim Bargon, have been published in the IBM Research Symposia Series. Papers included in the volume are on photo- and x-ray lithography, electron-beam lithography, reactive ion etching and more. Costing $59.50, it is published by Plenum Publishing Corp., 233 Spring St., New York, N.Y. 10013.
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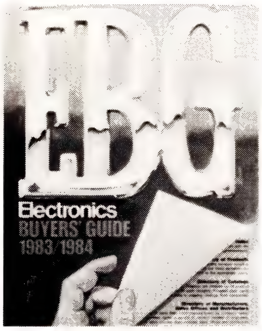

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LETTERS

BJT versus GaAs

To the editor: We are again presented with one of the numerous articles praising the virtues of gallium arsenide IC technology [*ElectronicsWeek*, April 1, 1985, p. 24]. Actually, BJT [bipolar junction-transistor] devices at the low currents required for LSI applications are far less affected by fringing and line capacitances than GaAs because diffusion capacitance is still dominant.

Enormous advances have been made with advanced high-speed BJT technologies yielding transit frequencies in the range of 10 to 17 GHz, even at low operating currents.

What's overdue is an article on high-speed bipolar circuits to counter the enormous GaAs propaganda machine.

Siegfried Knorr, President
Colby Instruments Inc.
Santa Monica, Calif.

Time will tell

To the editor: While "Engineering Faculty Shortage" [*ElectronicsWeek*, May 13, 1985, p. 13] depends on a number of commonly accepted precepts, a few of them need closer examination.

For example, the assumption that the salary for engineering faculty is too low fails to take into account the amount of time that is actually spent in teaching. When you subtract all the free time that goes with a teaching post, including fall, spring, Christmas, and summer vacations as well as the common one day per week free of classes, you are left with approximately 7½ months of teaching time per year. That means that a full professor of engineering paid $35,000 for the school year has a $56,000 salary figured on a 12 months' basis.

William Rynone
Millersville, Md.

Corrections

In ElectronicsWeek, *April 22, 1985, p. 14, Apollo Computer Inc.'s Domain/Dialogue management system was reported to cost $10,000 per site. That cost, says Apollo, applies to the per-site cost of the design kit. Apollo gave no prices for the management system.*

In ElectronicsWeek, *May 27, 1985, p. 64, the active area of the model GP-8-3D-P sonic digitizer from Science Accessories Corp. was given as 10 by 10 by 10 in.; the correct dimensions are 10 by 10 by 10 ft.*

The name of the Darpa scientist mentioned in ElectronicsWeek, *May 20, 1985, p. 22, is Sherman Karp, not Sheldon Karp as reported.*

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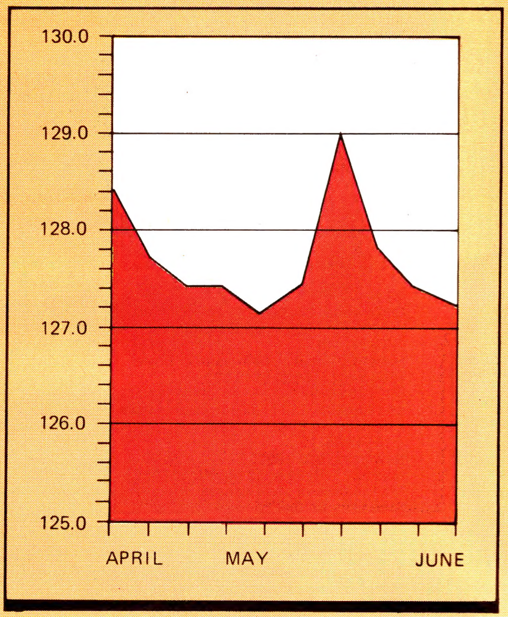

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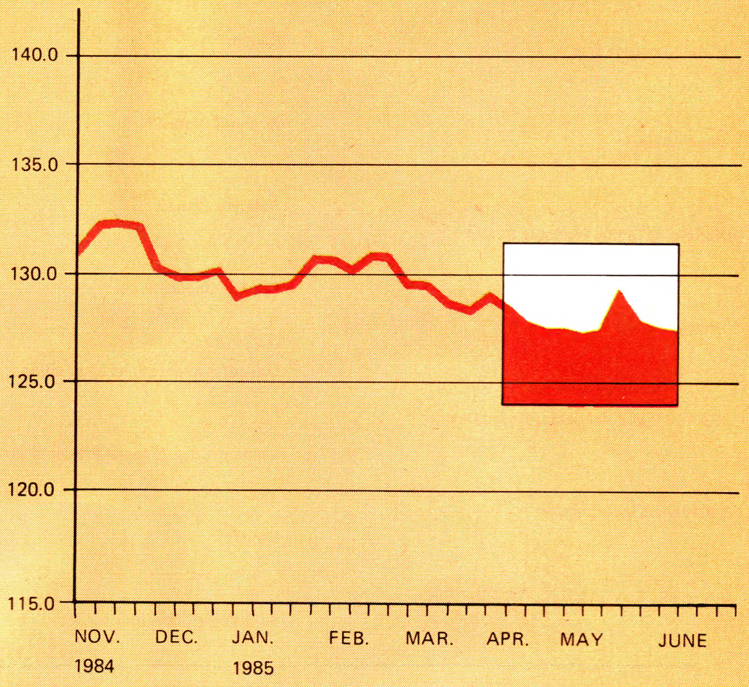


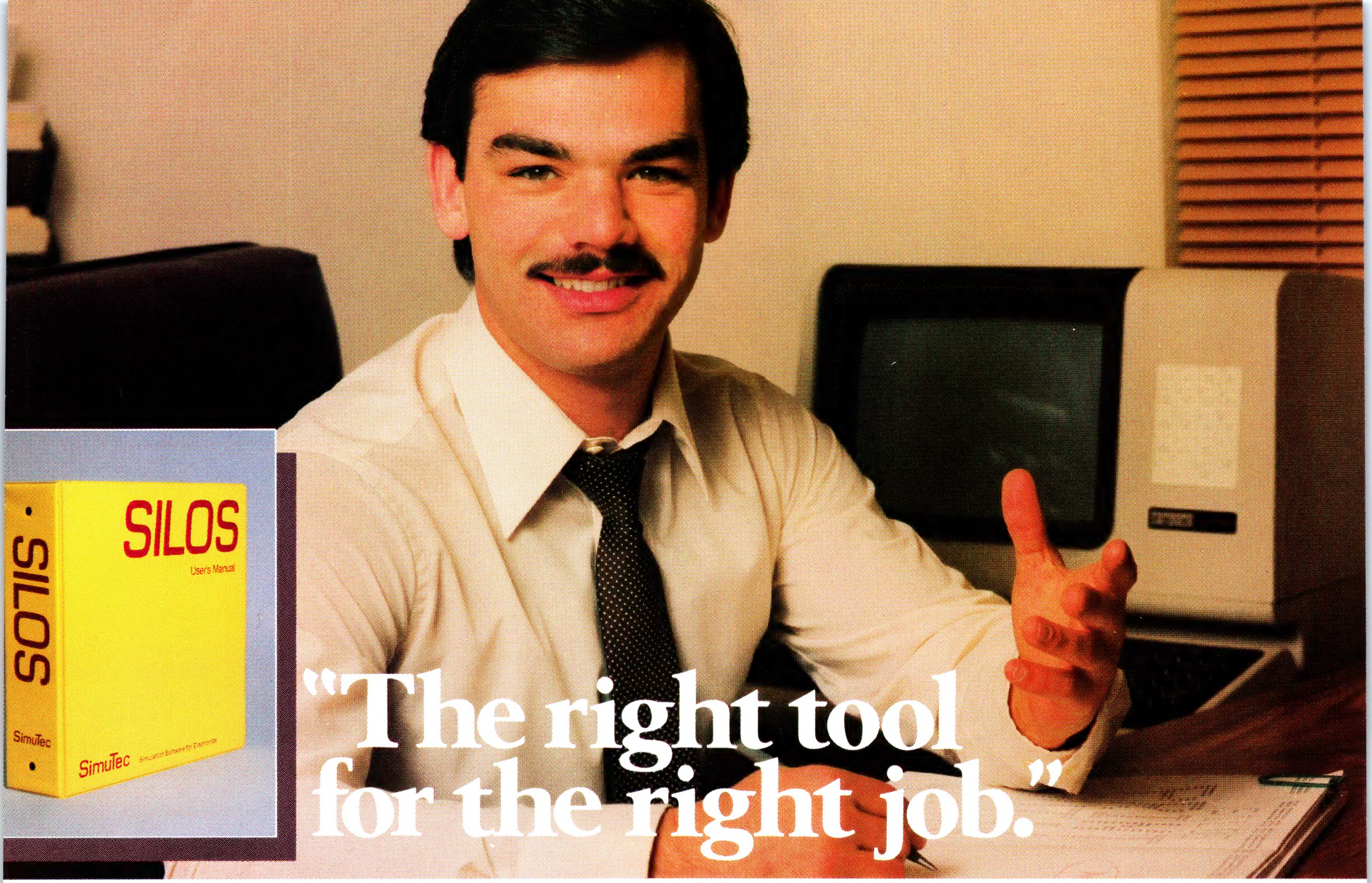
The *Electronics* Index, a seasonally adjusted measure of the U.S. electronics industry's health, is a weighted average of various indicators. Different indicators will appear from week to week.

U.S. ELECTRONICS IMPORTS AND EXPORTS (*$ millions*)

	IMPORTS			EXPORTS		
	April 1985	March 1985	April 1984	April 1985	March 1985	April 1984
Accounting, computing, and data-processing machines	329.794	342.240	259.932	562.275	783.125	528.773
Calculators	53.372	56.163	44.867	6.314	9.460	6.314
Parts for data-processing machines and office calculators	338.691	369.056	370.142	583.425	696.167	474.726
Telecommunications, sound-recording, and sound-reproducing equipment	1,650.847	1,661.689	1,368.993	321.971	467.097	341.297
Electronic or electric instruments	128.461	154.784	123.596	519.991	694.151	503.153
Printed-circuit boards	21.214	24.638	20.175	25.692	29.525	20.108
Integrated circuits, diodes and other semiconductors, tubes, piezoelectric crystals, parts	650.397	653.302	695.982	347.426	522.982	490.337
Fixed and variable resistors	20.869	24.680	28.487	13.100	15.253	17.097

Yet another drop in exports by the U.S. electronics industry pushed the *Electronics* Index down for the third consecutive week. While the decline in the Index was less than 0.2%, it does bring the industry barometer closer to last year's levels—a sobering commentary on what used to be a rapidly growing industry. Many, if not all, of the problems that the U.S. electronics industry is suffering can be traced to an ongoing loss of both domestic and overseas markets to foreign competition, a problem that is worsened by the current high levels of the U.S. dollar.

For example, the gains that manufacturers scored in their equipment exports in March proved to be short-lived. According to the latest Commerce Department statistics, exports of electronics equipment in April were down 7.5%, with lower results in every segment of the industry. Exports of electronic instruments dropped 17% in the month; data-processing-machine exports fell 3.6%; resistor exports slumped 15%; and circuit-board shipments to overseas markets dipped 14%. And even though imports to the U.S. of electronics equipment were down in that month as well, they slipped only 2.9%. As a result, the U.S. electronics trade deficit jumped by 14% to just over $800 million.



"The right tool for the right job."

How many times have you
heard that phrase? Yet
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neers using such unsophis-
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That's what SILOS™,
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EAL WORLD MODELING.

When it comes right down
the most efficient model is
that looks and acts like the
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WE GIVE YOU
MEANINGFUL FEATURES.

Features are important only if they allow you to model the real world in a flexible and useable way.

Some simulators give you a lot of features because they need to disguise their inability to model reality. SILOS gives you the features you need to get your job done accurately and reliably with a model that looks and acts like your design.

WE GIVE YOU SERVICE.

We can't promise an instant solution to your problems. But we can promise that we'll address your needs within 4 hours of your call, if not immediately.

We believe that service is not a sometime thing. We believe that helping our customers should be an ongoing service, and we deliver that service before, during and after the sale both directly and through our growing network of OEMs and Distributors.

Our support people include experienced design engineers who understand your needs and can help you with design modeling problems.

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The people at SimuTec started the software simulation revolution more than 15 years ago and have since developed increasingly mature design tools with programs like: ASPEC™, LOGIS™ and ILOGS™. Today, we combine that experience in SILOS™.

Equally important is the fact that more established MOS/VLSI design companies have used our products for more years than they've used all of our competitors' products combined.

No other company understands your engineers' real world problems while offering the features, the service and the experience that we can. We stand ready to give you the modeling capabilities you need now and in the years ahead.

SILOS™, SIMUTEC'S
LOGIC SIMULATOR.

Turn to us for the right tools to do the tough part of your design.

SILOS™ FEATURES INCLUDE:

POWERFUL MODELING ELEMENTS:

Models high level functions such as gates, ROMs, RAMs and PLAs as well as lower level primitives like transistors, resistors and capacitors. Bidirectional signal propagation, charge decay, charge sharing, zero or finite delays, spike and instability identification.

Allows addition of user-definable functional block subroutines.

EXPANDED MODELING STATES:

- *Our unique 12+4 state concept – three logic "levels" (low, high and unknown), each with four possible "strengths" (supply, driving, resistive and high Z), allowing wired-AND and wired-OR configurations. Added to this is our "Unset" state and three decay states.*

FAULT SIMULATION:

- *Enhanced concurrent fault simulation handling both unidirectional and bidirectional circuit models; full input and output stuck fault simulation using compensated fault collapsing; statistical sampling and controlability reporting.*

EASE OF USE:

- *Interactive or batch logic and switch level simulation; Simulation history storage and restart capability; Versatile macro definitions with deep nesting capabilities; Automatic verification of the logical consistency of all the network states prior to time-dependent simulation.*
- *Logic analyzer type graphics outputs.*

COMPATIBILITY:

- *SILOS Interfaces to the most advanced complementary packages, such as ECAD™, Mentor Graphics™, Chromatics™, Corydon Technology™, Daisy™ and Silvar-Lisco™. Available for installation on most 32 bit mainframes and most popular workstations.*

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SEE US AT BOOTH NUMBERS 352 AND 353 AT THE 22ND IEEE/ACM DESIGN AUTOMATION CONFERENCE IN LAS VEGAS, JUNE 1985

Circle 901 on reader service card

There's Room in One LCD Module for the Entire Globe.

–It Displays 2,000 Characters on a Large Screen–

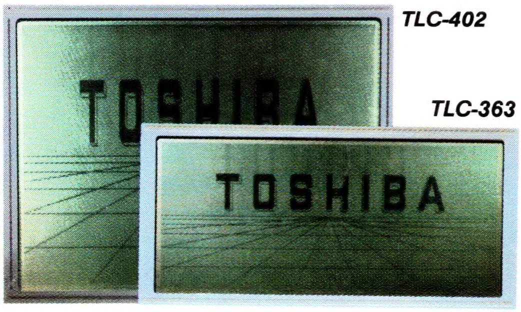
Simulated

New LCD modules from TOSHIBA give you 640 × 200 dot displays plus your choice of display area: virtually the size of an ordinary magazine or half that size.

The large display area puts a lot of information on view – either module can give you an array of 80 characters × 25 lines. Yet TOSHIBA technology cuts bulk and power consumption to the bone. These slim LCD modules are battery-powered, and they are compatible with current CRT displays without changing software.

All these features add up to portability. Versatility. Usability. These LCD modules are ideal as displays for portable word processors, personal computers, POS terminals and other display terminals.

Ask us. TOSHIBA is there when it comes to the technology you need in LCD components.



Specifications

		TLC-402	TLC-363
Display			
Number of Characters		80×25 (2,000 characters)	80×25 (2,000 characters
Dot Format		8×8, alpha-numeric	8×8, alpha-numeri
Overall Dimensions (W×H×D)		274.8×240.6×15.0 mm	275.0×126.0×15. mm
Maximum Ratings			
Storage Temperature		–20 – 70°C	–20 – 70°C
Operating Temperature		0 – 50°C	0 – 50°C
Supply Voltage	V_{DD}	7 V	7 V
	V_{DD}-V_{EE}	18 V	18 V
Input Voltage		$0 \leq V_{IN} \leq V_{DD}$	$V_{SS} \leq V_{IN} \leq V_{DD}$
Recommended Operating Conditions			
Supply Voltage	V_{DD}	5 ±0.25 V	5 ±0.25 V
	V_{EE}	–13 V Max.	–13 V Max.
Input Voltage	High	4.0 V Min.	4.0 V Min.
	Low	0.5 V Max.	0.5 V Max.
Typical Characteristics (25°C)			
Response Time	Turn ON	300 ms	300 ms
	Turn OFF	300 ms	300 ms
Contrast Ratio		5	5
Viewing Angle		15 – 35 degrees	15 – 35 degrees

Design and specifications are subject to change without notice.

TOSHIBA

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